AMERICAN JOURNAL OF ORTHODONTICS

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Vol. 47 FEBRUARY, 1961 No. 2

WILLIAMS

Precious Metal

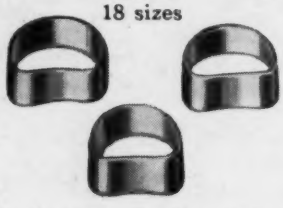
BANDS

- Time-Savers, Whatever your Technic
- For Better-Fitting, More Functional Appliances

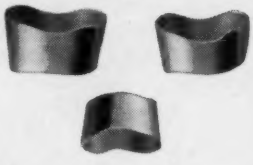
CONTOURED SEAMLESS BANDS

MOLAR
.006″ or .007″
24 sizes

ANTERIOR
.004″
18 sizes



BICUSPID
.004″
6 sizes



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ADJUSTALOOP PLAIN
.007″
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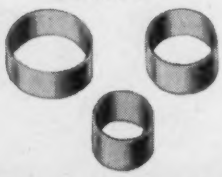

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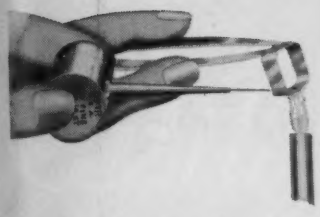
BAKER ORTHODONTIC GOLD SOLDERS



Baker Solders are named according to their fineness as stamped. They have unusual wetting properties, flow freely and form strong, dense, smooth joints without gaseous pits. Our solders are not brittle in wire form. They are packaged on spools of 5 dwts. to fit our spout containers. 28 gauge (.013″), 25 gauge (.018″), or very heavy 23 gauge (.022″). In 1 dwt. pieces, 1 dwt. narrow strips, 2 dwt. wide strips. 14K 450 Fine is a Universal Solder used for all types of connections on steel as well as precious metals. 18K 650 Fine is higher fusing. We list other Orthodontia Solders.

★ ★

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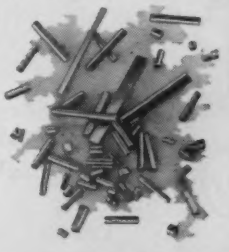
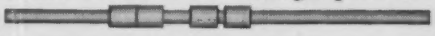


We supply Oralium tubes and tubing almost exclusively because of its hardness, non-stretching qualities and high fusing point. It does not oxidize and is low in cost. All Baker tubing is drawn to fit our wire precisely and is exceptionally smooth and uniform.

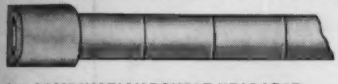
All round tubing has a wall thickness of .012″.

All lingual tubes have a wall of .015″.

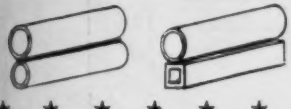
Always order half-round Oralium Tubes mounted on a straight piece of Q-A Post wire to insure fit.



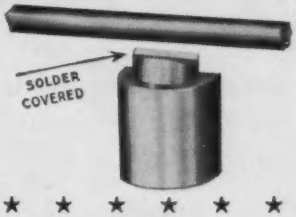
D-SHAPE TUBES AND POSTS COME ON Q-A SEGMENTED WIRE TO FIT.



ALL COMBINATION DOUBLE HEADGEAR TUBES. SAVE CONSIDERABLE TIME.



HALF-ROUND TUBES AND POSTS TUBES HAVE A SHEET OF SOLDER IN PLACE. POSTS ARE GROOVED OUT TO RECEIVE WIRE.



SYMMETRICAL D-SHAPE TUBE AND POST COLLAR SNAPS OVER ARCH WIRE AND IS PLACED IN PERFECT POSITION BEFORE SOLDERING. MADE TO FIT .036, .038, .040 ARCH WIRE.

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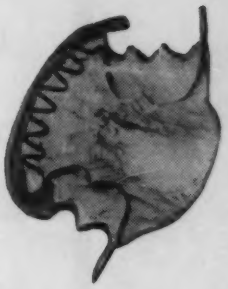

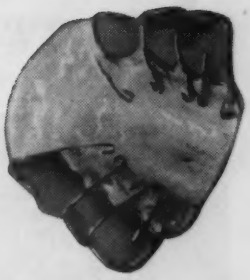

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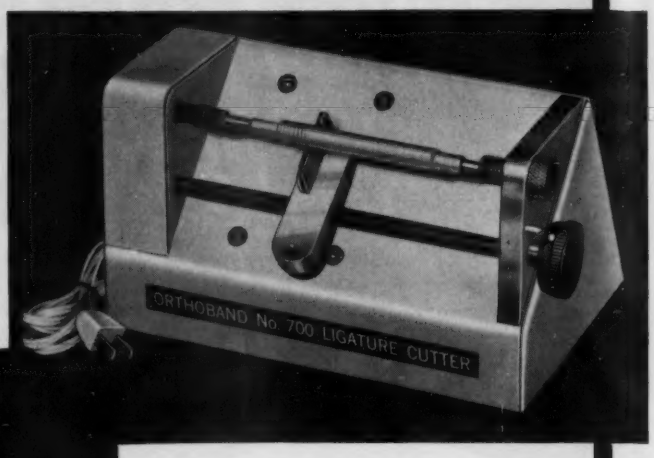

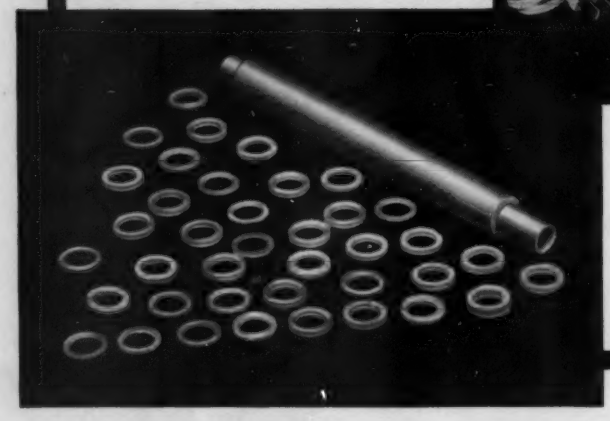

Above: Orthoband Model 700 Ligature Cutter. At left: Orthoband Latex Rubber Ligature Tubing on cardboard core. Also ligatures in varying widths, cut on Model 700.

THE ORTHOBAND LIGATURE CUTTER

- Cuts Ligatures from latex rubber tubing* in multiples of 1/32-inch: 1/32-inch; 1/16-inch; 3/32-inch; 1/8-inch; and wider if desired. Note illustration.
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*ORTHOBAND LATEX RUBBER LIGATURE TUBING

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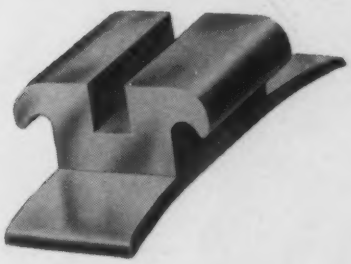
GT-2	Posterior Edgewise Brackets
GT-3	Wide Double Edgewise Brackets
GT-4	Medium Double Edgewise Brackets
GT-5	Narrow Double Edgewise Brackets
GT-6	Extra Wide Double Edgewise Brackets



PREWELDING SERVICE—Any of the above brackets may be obtained as Prewelded Band Material Assemblies, securely and precision welded on our electronic equipment.

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Write for our price listing of Brackets and Prewelded Assemblies. See how you can save 25% of your actual costs.

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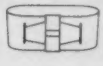
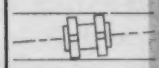


BRACKETS WELDED TO SEAMLESS ANTERIOR OR SEAMLESS CUSPID BANDS/Brackets are accurately positioned on these bands using precision welding tooling. Always uniform, always securely welded. Seating lugs are routinely welded to the lingual side of these bands.

BRACKETS WELDED TO LOOP BANDS/Straight band material with brackets welded receive one additional operation to save you time. The bands are formed to the figure eight shape required for Howlett band forming pliers, and the ends are welded together ready for use. Cuspid bands or bands with Steiner or UT-380 brackets cannot be looped.



ANGULATION WELDING/For those Doctors using the recent technique of positioning the bracket on the band at a pre-determined angle to avoid excessive tip-back bends in the arch wire, we offer this additional service. Precise tooling enables us to weld the bracket at any angulation to the occlusal plane.

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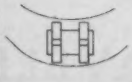

OFFSET INCISALLY/Any bracket and band combination can be ordered with the bracket offset incisally. The standard amount of offset is .025 above the center line. Brackets may be ordered offset more, or less, than this amount to meet your specific requirements.

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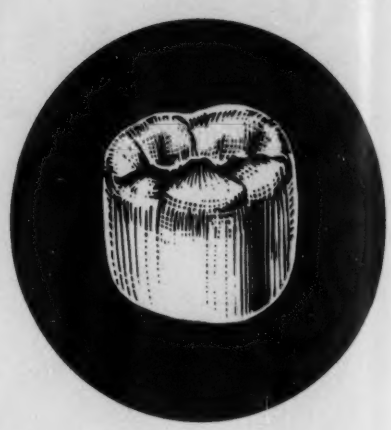

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for cuspid band technic— tooth jumping—space maintainers

- **As easy to cut and fit as gold**—because they're bright annealed and extra soft
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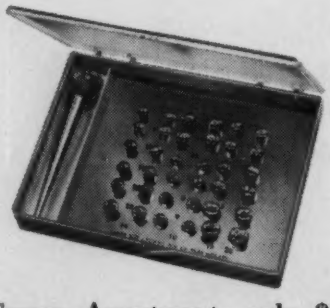
- **Performed occlusal**—no interference with normal mastication
- **Widest size selection**—precisely graduated
- **And they last!**—Just buff lightly at low speed for instant hardening, almost indefinite wear!



36 Crown Assortment—only $14.40
in plastic jewel case with free crown gauge

CUSPID BAND TECHNIC

When a cuspid is to be banded as part of an orthodontic appliance, the use of stainless steel crowns offers distinct advantages:

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Crowns are more rigid than simple bands—and less subject to material distortion . . .

Crowns protect the tooth enamel.

Crowns are fitted as follows—

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2. Measure tooth from incisal edge to gingival margin.
3. Inscribe inciso-gingival measurement on crown; allow a little extra length for festooning and gingival adjustment.
4. Cut off incisal tip of crown.
5. Festoon gingival of crown; contour as needed.
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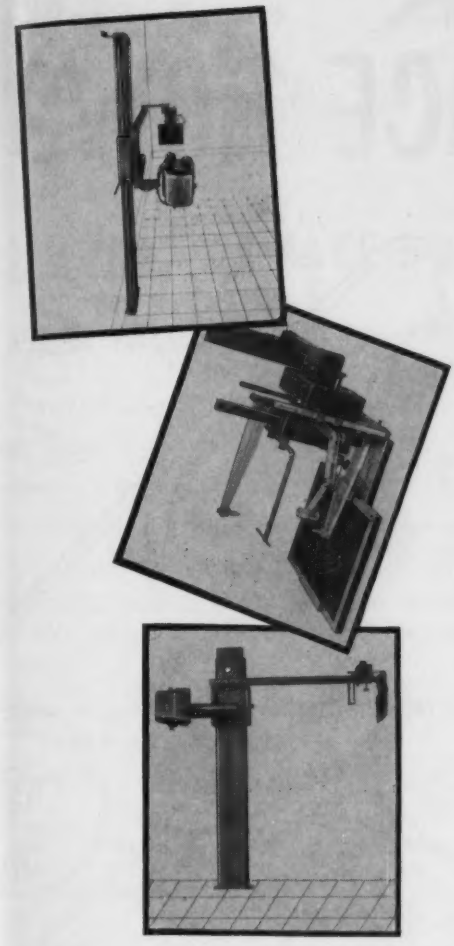

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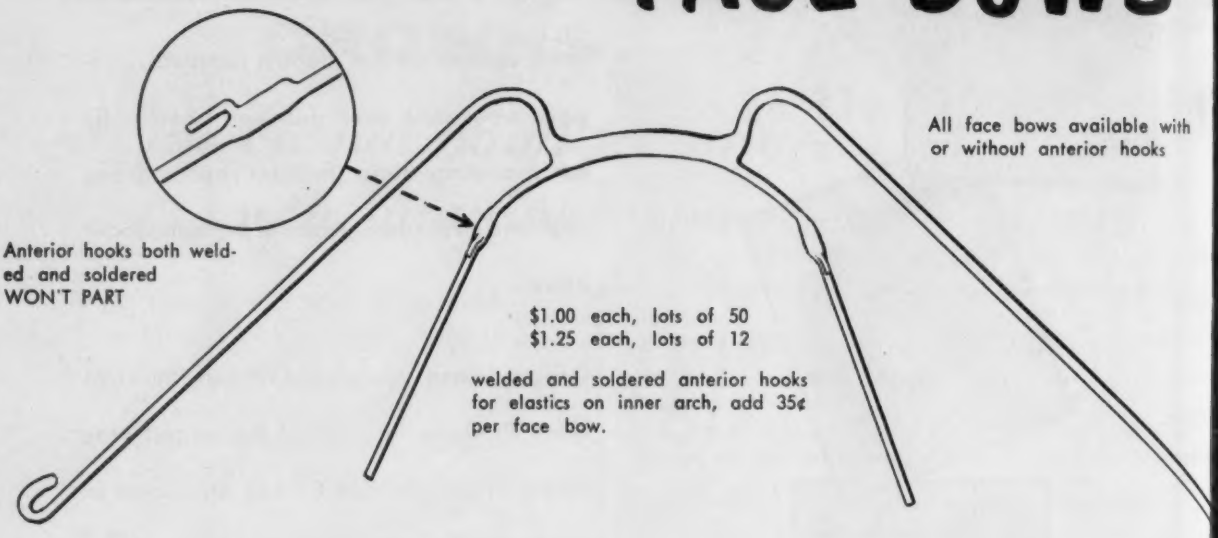


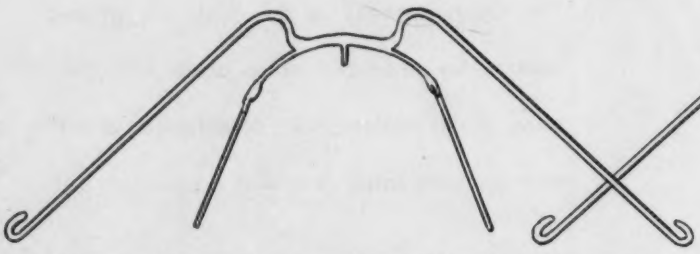
Anterior hooks both welded and soldered WON'T PART

All face bows available with or without anterior hooks

$1.00 each, lots of 50
$1.25 each, lots of 12

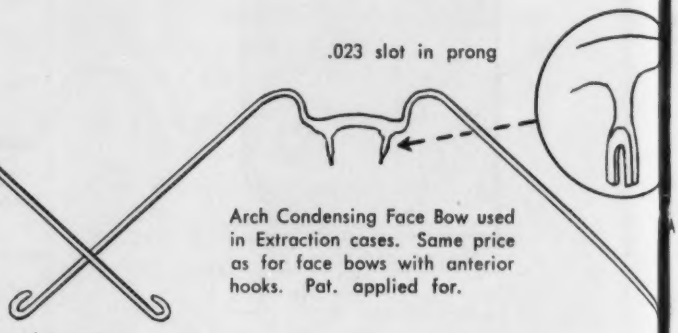
welded and soldered anterior hooks for elastics on inner arch, add 35¢ per face bow.

Face Bows can be assorted for quantity prices

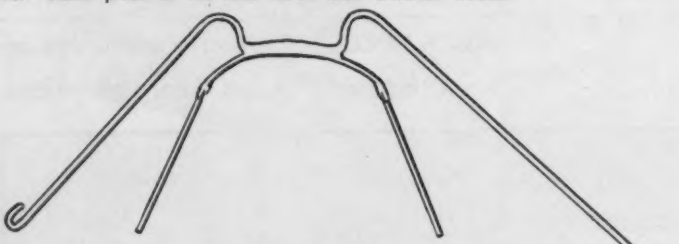


Center Spur Face Bows. By adjusting outer arms up and inserting center spur incisal to arch wire, when neck strap is applied, a high pull incisor action will help correct deep overbites. By adjusting outer arms down and inserting center spur gingivally to the arch wire, a low pull incisor action will help correct open bites. Same price as for face bows with anterior hooks.

.023 slot in prong



Arch Condensing Face Bow used in Extraction cases. Same price as for face bows with anterior hooks. Pat. applied for.



Long Arm Face Bow
Long arm is traction side.

Preformed Labial Arches. Uniformly shaped to the average arch. Only slight adjustments necessary to fit. .032, .036, .040, .044 and .050 available, $12.50 per hundred. Sizes may be mixed for quantity price.

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slide smoothly thru buccal tubes

Heavy Face Bow Adjusting Pliers. Front section of face bow can be adjusted to form of malocclusion, either V shaped or squared for high cuspid cases at start of treatment and then reshaped to ideal form as case progresses. Pliers $10.00

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PLAIN FACE BOWS—NO ANTERIOR HOOKS
.044 inner arch—.060 outer arms

.044 inner arch.

.044 inner arch with center spur.

.044 inner arch—one outer arm much longer.
Longer arm is power side.
No movement on short arm side.

A .044 inner arch—one outer arm is ¼" shorter.
Longer arm extended for power action.
Most useful for average case, where retraction is necessary in both buccal segments, but a little more necessary on one side.

.044 inner arch with ends of both outer .065 arms straight and one inch longer.

& CS .044 inner arch same as above but with center spur.

FACE BOWS WITH WELDED AND SOLDERED ANTERIOR HOOKS
.044 inner arch—.060 outer arms

.044 inner arch.

.044 inner arch with center spur.

Left / Right .044 inner arch—one outer arm much longer.
Longer arm is power side.
No movement on short arm side.

Left / Right .044 inner arch—one outer arm is ¼" shorter.
Longer arm extended for power action.
Most useful for average case, where retraction is necessary on both buccal segments, but a little more on one side.

.044 inner arch with ends of both outer .065 arms straight and one inch longer.

& CS .044 inner arch same as above but with center spur.

PLAIN FACE BOWS—NO ANTERIOR HOOKS
.050 inner arch—.060 outer arms

150P .050 inner arch.

151CS .050 inner arch with center spur.

152LA .050 inner arch—one outer arm much longer.
Longer arm is power side.
No movement on short arm side.

153SLA .050 inner arch—one outer arm is ¼" shorter.
Longer arm extended for power action.
Most useful for average case, where retraction is necessary on both buccal segments, but a little more necessary on one side.

154SE .050 inner arch with ends of both outer .065 arms straight and one inch longer.

155SE & CS .050 inner arch same as above but with center spur.

FACE BOWS WITH WELDED AND SOLDERED ANTERIOR HOOKS
.050 inner arch—.060 outer arms

250AH .050 inner arch.

251CS .050 inner arch with center spur.

252LA Left / 253LA Right .050 inner arch—one outer arm much longer.
Longer arm is power side.
No movement on short side.

254SLA Left / 255SLA Right .050 inner arch—one outer arm is ¼" shorter.
Longer arm extended for power action.
Most useful for average case, where retraction is necessary on both buccal segments, but a little more on one side.

256SE .050 inner arch with ends of both outer .065 arms straight and one inch longer.

257SE & CS .050 inner arch same as above but with center spur.

301 Arch condensing face bow. Two prongs with .023 slot, welded and soldered. WON'T PART. Used in extraction cases to close anterior spaces in either maxillary or mandibular arch. Outer arms .060

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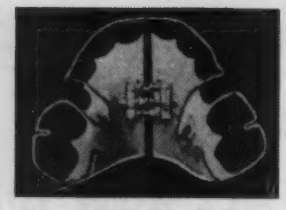
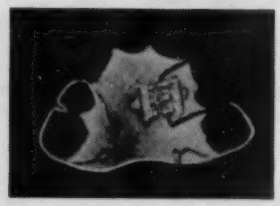
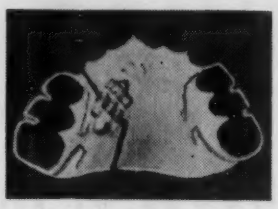
Simple reliable regulating devices for individual and mass movement of teeth



For lateral expansion

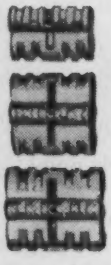


For buccal and labial movement of one or more teeth



For distal movement of one or more teeth

Three convenient sizes in stainless steel



	Length	Width	Thickness	Expansion Capacity
No. 111F (small)	**10 mm**	**7 mm**	**4 mm**	**6 mm**
No. 110D (medium)	**10 mm**	**9 mm**	**4 mm**	**5 mm**
No. 110C (large)	**13 mm**	**8 mm**	**4 mm**	**6 mm**

Supplied with adjustment wrench and acrylic guard mounted in screw to protect mechanism during processing. Each 360° turn of wrench expands screw 0.8-0.9 mm.

PRICE: $50.00 per doz. (your assortment) . . . $4.25 per single screw

LABORATORY TECHNIC FOR PROCESSING EXPANSION SCREW APPLIANCES*

Many doctors have asked us for information on construction of expansion screw appliances. The following technic is available on request . . .

1. Tinfoil model, or use foil substitute. For appliances involving buccal or labial movement of teeth, use a heavy layer of tinfoil under segment to be moved, to avoid pressure on tissue.
2. Wax clasps, springs and labial to model in proper position; shape wax on model to desired design and trim to sharp outline.
3. Carefully imbed expansion screw (with acrylic guard in place) into wax-up so it is just touching surface of foiled model. Position of expansion screw's axis is important: it must lie parallel to occlusal plane of teeth to be moved.
4. Flask and process acrylic as usual.
5. After processing, separate flask and remove acrylic guard from expansion screw by bending it back on itself with a rocking motion. Then remove appliance from model and cut it into desired segments, using a saw or fissure bur.
6. Polish and finish as usual. The completed appliance should fit snugly; adjust any rocking or play.

When using cold cure acrylic—

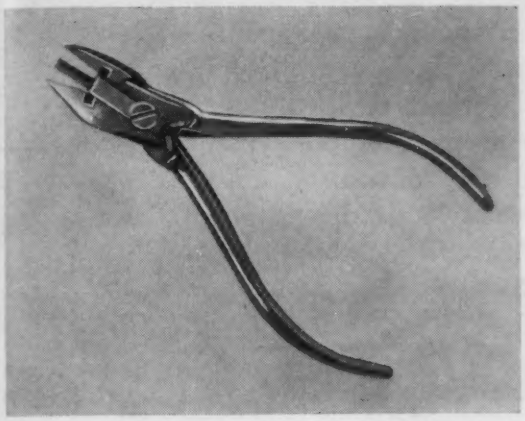
Wax all wires to model on buccal, leaving lingual surface clear of wax. Place a thin layer of acrylic in area where expansion screw is to be set.

Press screw firmly into place, just clear of surface of model; add a little acrylic to sides of screw to hold it firmly in place, then fill in rest of model to desired outline.

When acrylic has cured, complete appliance with steps 5 and 6 above.

**Suggested by S. Stolzenberg, Technician,* Brooklyn, N. Y.

. . . and PARKELL PLIERS for expansion screw appliances . . .

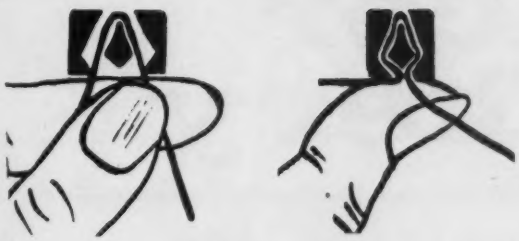


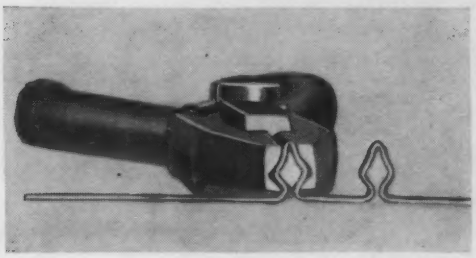
ARROWHEAD LOOP FORMER

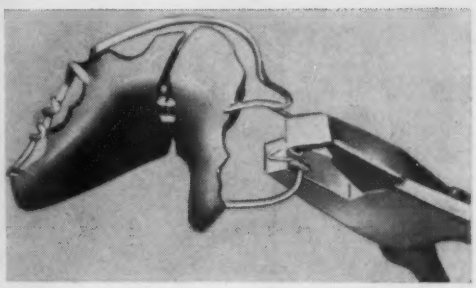
No. 5026

Forms arrowhead loops automatically

Simply bend wire into a "V" and place in the pliers as illustrated. Closing the pliers automatically forms the wire into a precisely shaped arrowhead loop. **$18.75**







ARROWHEAD LOOP ADJUSTER

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Specially shaped jaws grip arrowhead loops and bend them over into the desired relationship to the teeth. **$12.50**

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- ☐ Pliers as follows: ____ No. 5026 ____ No. 5028
- ☐ Your catalog of orthodontic pliers and specialties

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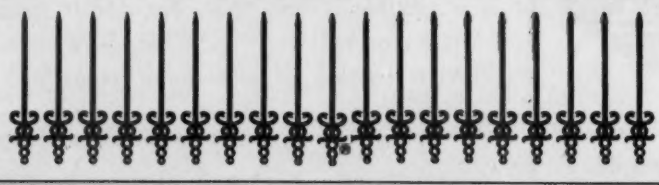
is dedicated to saving lives from cancer and spearheads the fight against cancer quackery. Its Committee on New or Unproved Methods of Treatment of Cancer has a membership of physicians, lawyers, educators, and public relations specialists. This committee has been a prime mover in developing constructive action

against cancer quackery

Inspired by model legislation formulated by this committee with the active cooperation of the California Medical Association, California, Kentucky and Nevada recently passed bills providing the first effective means of fighting cancer quackery at its base of operations—in the local community.

To keep both the public and the medical profession informed, the Society has established, in its national office, a central repository of material on new or unproved methods of cancer diagnosis, treatment and cure—a principal source of such information in this country.

The American Cancer Society, in this as in all its efforts, serves both the private citizen and the practicing physician—and is, in turn, served by both.



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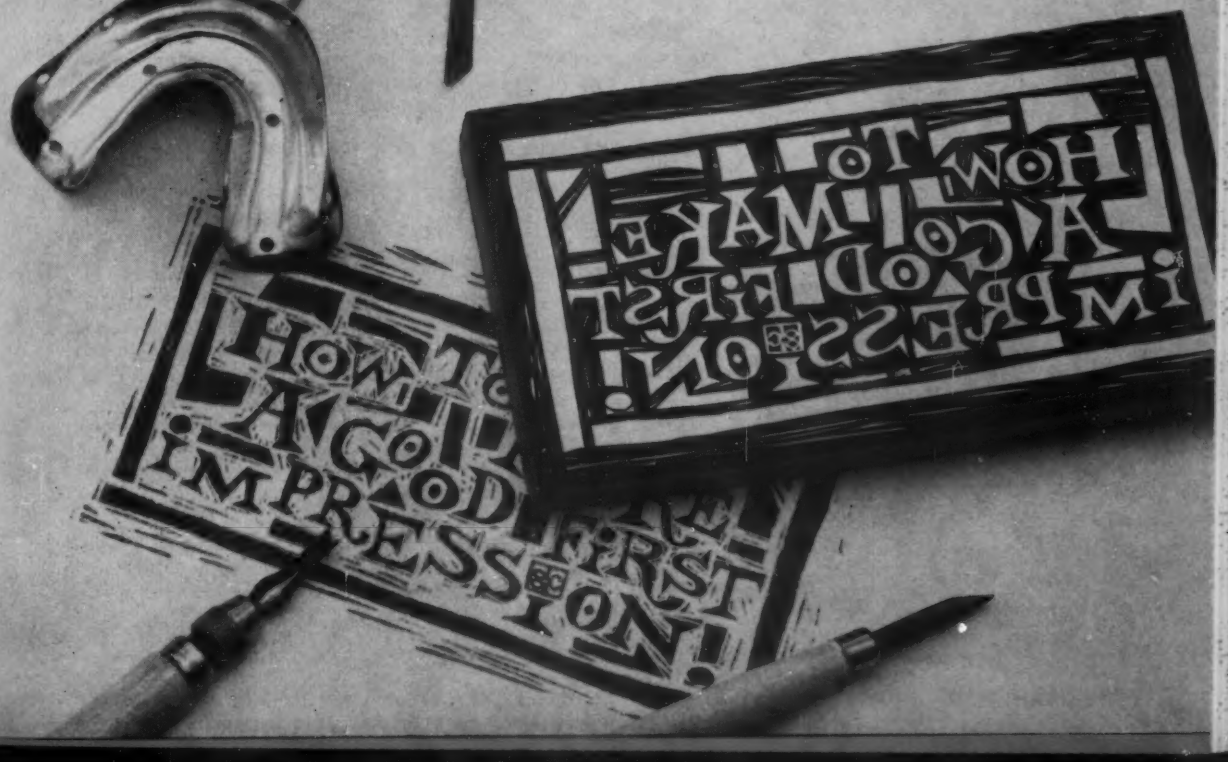

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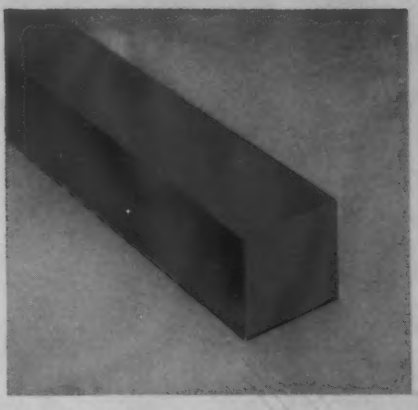

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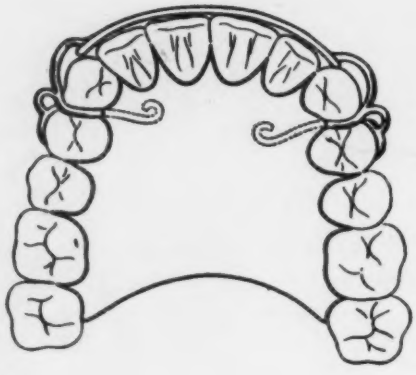

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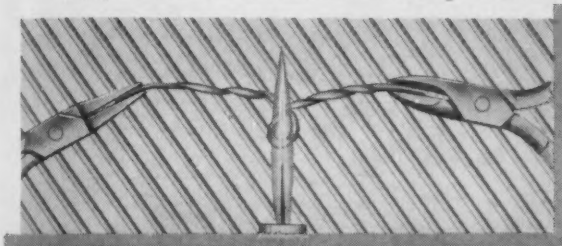

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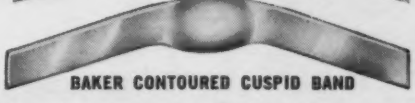

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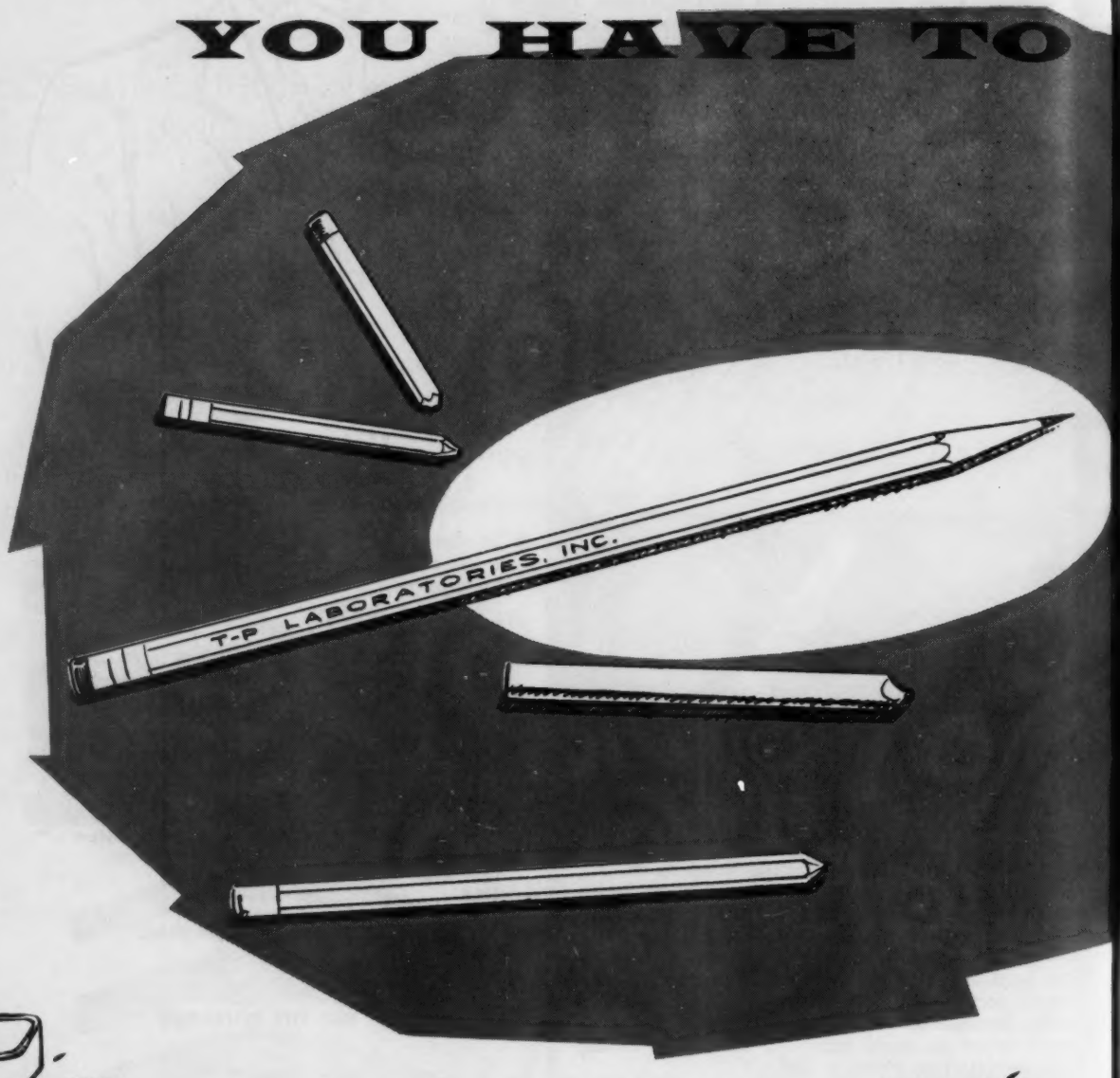

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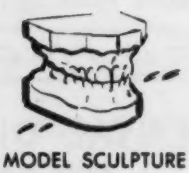

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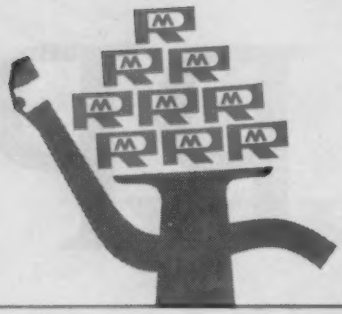

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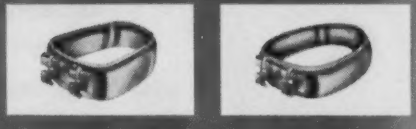

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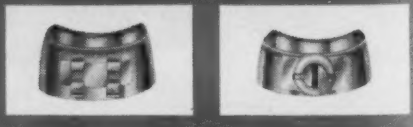

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Original Articles

SOME ASYMMETRIES OF THE DENTAL ARCHES, JAWS, AND SKULL, AND THEIR ETIOLOGICAL SIGNIFICANCE

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RESEARCH in biology is essentially concerned with elucidating the causes of the extraordinary variability that is a characteristic of life in its various forms. This variability is most clearly manifested in the enormous number of forms of life in the plant and animal kingdoms—from one-celled, comparatively simple organisms to the most complicated creatures. The unit in this series is the species, which is a collective term for individuals that have striking genetic, morphologic, and physiologic similarities. The similarity between different individuals of the same species is only relative, however, for those individuals can differ widely in detail. This is certainly true in the species in which we are most interested, namely, man.

This biologic variation, whether it be between different species or between individuals of a particular species, is attributable to factors of two main types—genetic and nongenetic—and it is of special interest to distinguish between them. The genetic variations are due to differences in the genes in the gametes, and it is the gene combination of the individual that decides its development in essential respects. The genotype can be modified to a greater or lesser degree, however, by nongenetic influences, so that different phenotypes occur in a particular genotype. From the biologic standpoint, of course, it is of great interest to determine the phenotypic variation for a particular genetic composition—in other words, to determine the influence of nongenetic factors on different morphologic or physiologic properties.

Nature offers three main ways in which the nongenetic or phenotypic variation might be isolated, all based on the examination of differences between

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genetically similar units. The most common method involves a comparison between identical twins, triplets, and so on. Second, one may study the variation in populations of genetically similar individuals. Such populations are found, for instance, in the self-pollinating plants in the form of so-called pure lines. Among cross-fertilizing plants and among animals, populations that are practically identical in their gentic properties can be obtained by long-term inbreeding (for instance, by pairing siblings through a great many generations[6, 37]). The third method, which is applied to symmetric (especially bilaterally symmetric) organisms, involves a comparison of homologous sections (the two halves of the body) in an attempt to ascertain the effect of nongenetic factors on a particular individual.

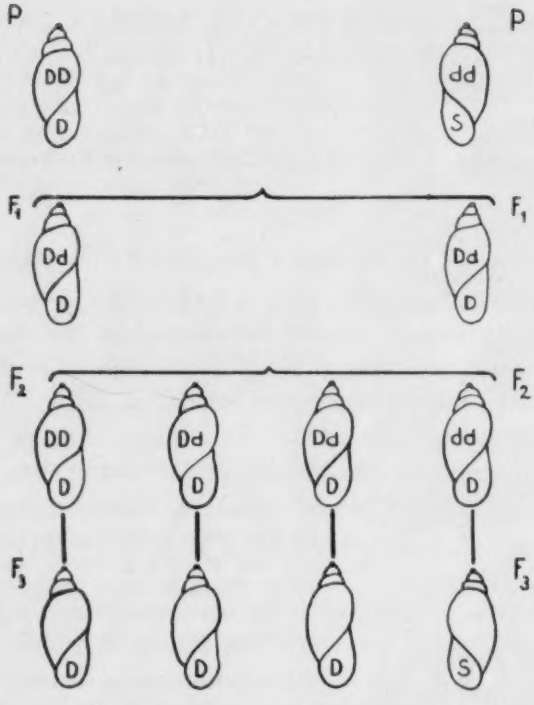

Fig. 1.—Inheritance of the direction of rotation in shells of *Limnaea peregra*. Observe that in spite of a homozygous gene composition for left-coiling in 25 per cent of the animals of F_2, left-coiling does not occur until the next generation. Left-coiling can manifest itself only if the egg has been produced by an animal that is homozygous for this trait. (From Dahlberg: *Proc. Roy. Soc. Edinburgh* s.B., p. 62, 1943.)

Each of these methods has its limitations. In this article I shall be concerned mainly with the third method and its value as a basis for studying the variability in the teeth, jaws, and face.

We must first decide whether we are justified in assuming that the two halves of the body are genetically identical with respect to the properties in question. This leads to the more general problem of right-left differences, and it may be of interest to consider these differences briefly before taking up the more specific questions.

The right-left problem[18] appears everywhere in nature where two congruent but mirror-image types occur. It might involve two individuals, as in the case of spiral forms (for instance, snails with shells having right or left directions of rotation as in Fig. 1), or a single individual with bilateral homology.

Since mathematically identical similarity between the two mirror-image forms cannot be expected in living things, bilateral symmetry is but a theoretical concept, a principle in biology which is applicable to large numbers but seldom, if ever, to the individual organism.

Whether or not the concept of basic symmetry is a realistic one depends, of course, on the extent to which the genetic forces that guide the growth of the individual are concerned with developing two identical mirror-image halves of the body. That such symmetry is deficient in important respects in many animals is a familiar fact. In mammals, for instance, there is marked asymmetry in shape and location of the viscera, especially as regards the organs of the alimentary canal and the circulation.

Phylogenetically, these asymmetries are of a secondary nature; that is, they have developed from an original bilateral symmetry. In the example that I have just mentioned, this would be due to an increase in the functional demands on the digestive apparatus and a consequent elongation of the alimentary canal which, to obtain room, assumed a spiral form and developed folds. The liver and pancreas develop from the foregut and therefore are involved in the general internal asymmetry. The asymmetry of the heart and of the blood and lymph vessel systems will have developed as a result of the different functional requirements on the left and right sides of the heart and the asymmetric positions of many of the organs that the vessels supply.

From the aspect of causation, it is evident that these deviations are of a genetic nature and thus originate in signals that determine the development and that are present in the genes.

The nature of these signals and the way in which they guide the ontogenetic development in this and other respects is obscure, despite the interesting results obtained in recent biochemical research on the nature and action of the genes.

In addition to the regular and highly consistent forms of asymmetry mentioned above, there are other genuine types of asymmetry. Among these might be mentioned right- and left-handedness and associated functional and morphologic asymmetry. The preference for one side over the other is not restricted to man.[18] An example of such differences in the animal world is found in certain types of claw in which the foremost pair of legs consists of one more powerful claw (the fighting claw) and a smaller one with which the food is placed in the mouth. In many species there is a definite tendency for the fighting claw to be located on one side (usually the right) more than on the other. In the case of the buck reindeer and some deer and wild oxen in Southeast Asia, on the other hand, the left side is reported to be the fighting side; this is reflected in the fact that the left horn is more strongly developed and more often broken than the right one. In these animals injuries to the forehead from fighting are reported to occur more often on the right than on the left side.

In civilized man right-handedness occurs in about 95 per cent and left-handedness in about 5 per cent.[18] In apes, on the other hand, there does not appear to be such asymmetry. Related to right- and left-handedness, there is also the preference for using the corresponding leg (for instance, for pushing off the ground in the long jump or for kicking a ball). Moreover, there is even a preference for using one eye more than the other as, for instance, when using a monocular microscope or in the perception of the eyes' double image of objects situated at different distances from the viewer. These relationships suggest that the preference for one side is deeply rooted and is associated with asymmetry in the central nervous system. Further proof of this is found in the well-known fact that the speech center is situated in the left cerebral hemisphere in right-handed persons and in the right hemisphere in left-handed persons. From a purely morphologic aspect, the differences between left and right are reflected in arm and leg length, the right arm usually being longer than the left and the right leg shorter than the left.[18, 31] These examples may suffice to show that systematic asymmetry is by no means uncommon, even with respect to parts of the body that are essentially similar in structure on each side.

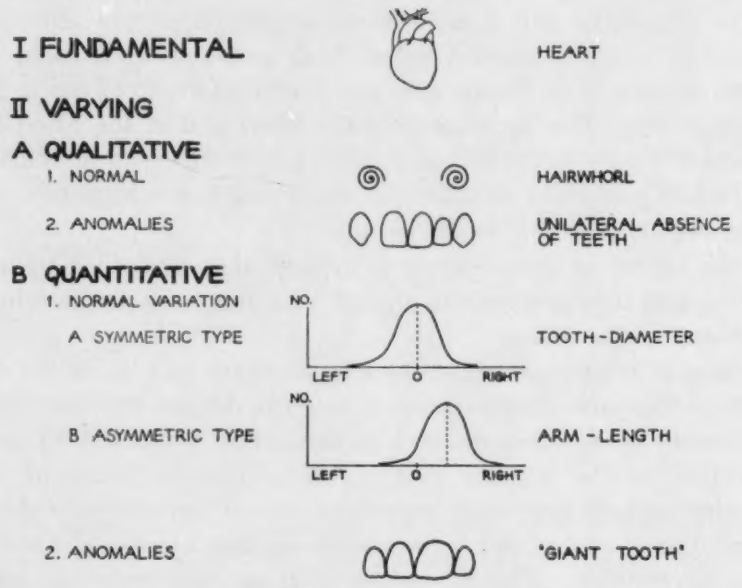

Fig. 2.—Classification of asymmetries.

Let us look closer at the various forms of asymmetry from the aspect of their classification. Several types might be distinguished (Fig. 2). The problem of mirror-image asymmetry in twins or the rare type of asymmetry known as situs inversus[32] will not be dealt with in this paper.

In the head it is the variable forms of asymmetry that are of primary interest, although we cannot rule out the possibility that fundamental asymmetry (for example, as regards the blood circulation) might have secondary consequences within the head and thus contribute to the occurrence of the variations.

What, then, is the magnitude of the right-left differences in the head? A curious point in this connection is the discovery by the German anatomist, Henke, that the classical sculpture Venus of Milo (Fig. 3) was not symmetric. Henke therefore considered that this statue did not deserve the great admiration bestowed upon it. Hasse[13] then examined the symmetry of Venus of Milo and of the faces of living subjects and found that facial asymmetry is, in fact, a

Fig. 3.—Venus of Milo. (From Poulsen, Vagn: Skulpturboken/Forntidens skulptur, Stockholm, 1947, Nordisk Rotogravyr.)

general phenomenon. The statue's conformity with this pattern was consequently declared to make the sculpture all the more wonderful. As an illustration of facial asymmetry, Hallervorden[11] cut *en face* photographs of the head in two and made up composite pictures consisting of the left side and its mirror image and the right side and its mirror image. Such pictures may be considerably different from one another and, moreover, present a stereotyped masklike appearance (Fig. 4).

From the orthodontic aspect, the asymmetries that are of special interest are those which might involve the occlusion. These may be classified in the following manner:

A. Qualitative asymmetry
   (1) Number of teeth
   (2) Cleft palate
B. Quantitative asymmetry
   (1) Size of the teeth
   (2) Location of the teeth in the dental arches
      (a) Anteroposterior position
      (b) Lateral position
      (c) Vertical position

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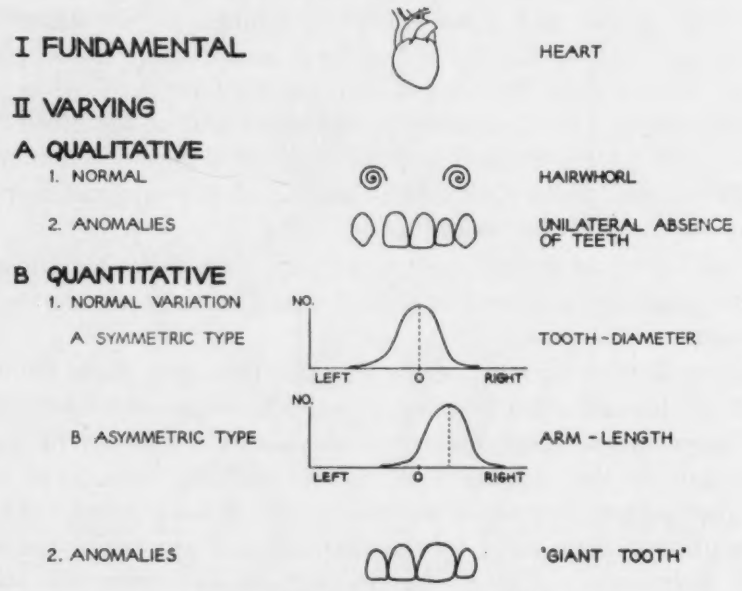

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      (b) Lateral position
      (c) Vertical position

(3) Location of the dental arches in the head
  (a) Rotation in the horizontal plane
  (b) Rotation in the frontal plane
  (c) Lateral translation

Since asymmetry in the number of teeth and their size will be dealt with in another article, I shall not dwell upon this feature now.

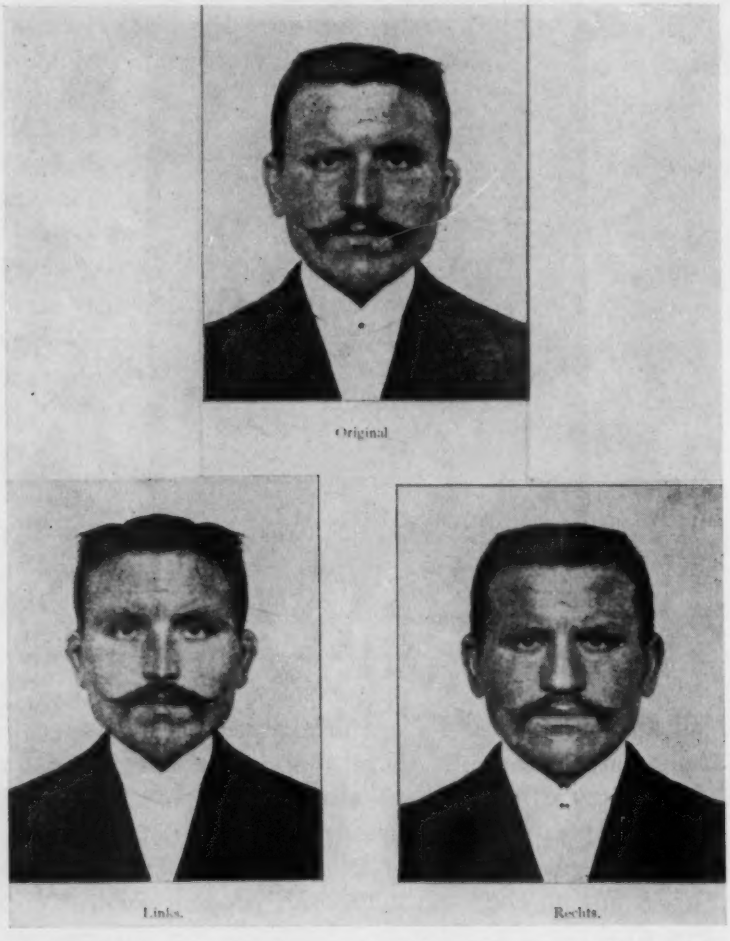


Fig. 4.—Photograph of a face and two composite pictures consisting of the left side and its mirror image and the right side and its mirror image. (From Hallervorden: *Psychiat.-neurol. Wchnschr.* 4: 309, 1902.)

Among the forms of qualitative asymmetry, cleft palate is of particular interest from the orthodontic standpoint. This malformation is usually unilateral, in spite of the fact that hereditary traits have proved to be involved in its etiology. Fogh-Andersen[7] found the following distribution of harelip and harelip with cleft palate in a series of 498 cases:

Bilateral			122
	Left	267	
Unilateral			376
	Right	109	
	Total		498

In hereditary cleft palate the gene or combination of genes responsible for the anomaly is most probably distributed to both sides of the maxilla. The fact that in spite of this the anomaly is not always bilaterally manifested might be due to incomplete penetrance of the responsible genes. A unilateral manifestation might, in such a case, originate in small differences between the right and left sides in the internal environment of the body during early embryonic life.[5, 19] It might, however, be a question of a genotypic asymmetry, such as right- or left-handedness. In some cases, perhaps, the anomaly might also be the consequence of a so-called somatic mutation (Fig. 5), in which there is a sudden change of a single gene in a somatic cell. If the mutation occurs during the intrauterine development, and if the changed gene is dominant, the cells that develop from the original cell can present phenotypic traits leading, for instance, to marked right-left differences.

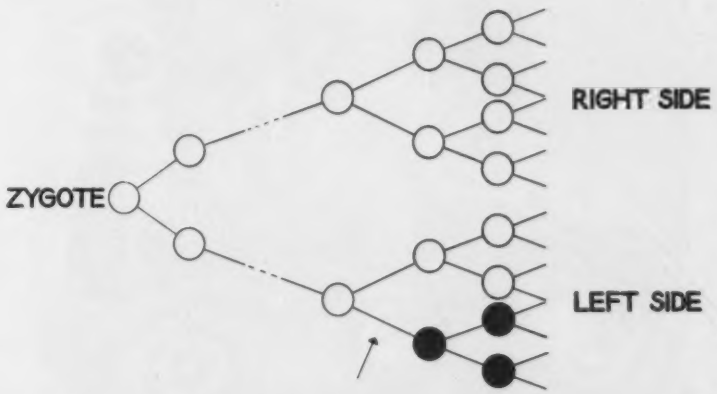


Fig. 5.—During the somatic differentiation a mutation, or a genetic disorder in the distribution of the genes, may occur. A somatic mutation may be observed in the phenotype in such cells as derive from the cell if the mutated allele is dominant.

One may wonder why unilateral cleft palate occurs roughly twice as often on the left side as on the right. It is difficult to suggest any nongenetic factor that might account for the less frequent closure of the palate on the left side than on the right. Therefore, it appears most likely that this phenomenon might be associated in some way with genetic differences between the halves of the body.

An examination of the positional symmetry of the teeth in the arches requires a coordinate system of the axes of symmetry for each dental arch.

As regards the upper jaw, it has long been the practice to use the raphe-median plane in such analysis, and the following technique is a suitable one (Fig. 6).

The raphe-median plane and the dental arch are projected by means of a stereograph on a sheet of paper, the cast being adjusted first so that the dental arch lies parallel to the plane of the paper. Since the arch does not form a geometric plane in the true meaning of the term, it will be necessary to use an approximation. For this purpose, three points are chosen that represent the plane of the arch—for instance, the mesiolingual cusp tips of the left and right

first permanent molars and the incisal edge of one of the incisors. Two points are now chosen on the raphe line—one immediately behind the incisive papilla and the other a posterior point as far back as possible on the raphe line, where this is clearly defined on the cast. By joining these two points, what may be regarded as the y-axis of the coordinate system is obtained. A line perpendicular to this and passing through a suitable point on the dental arch then gives the x-axis. The mesiolingual cusp tip of the right or the hindmost first permanent molar might be chosen for this purpose.

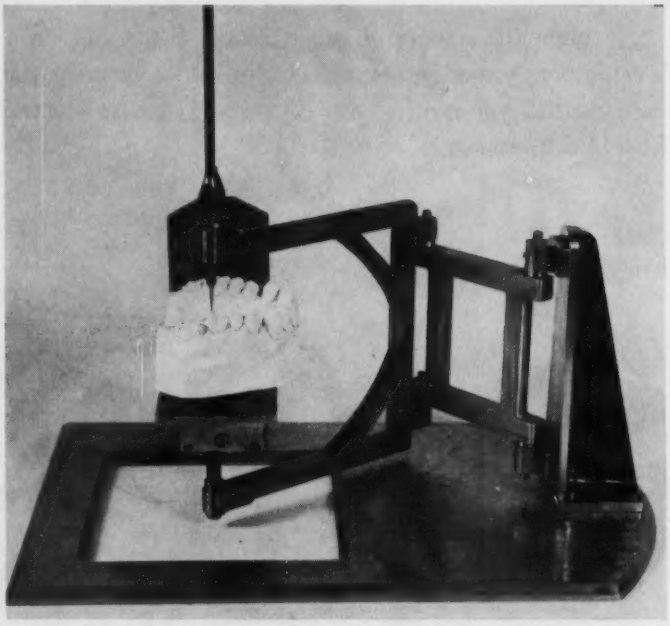


Fig. 6.—A modified version of the stereograph described by Schwarz,[29] useful for symmetry analyses of dental casts.

Clearly, with this coordinate system, only anteroposterior and lateral asymmetries can be determined. Local vertical asymmetries in the dental arch can be determined, however, by means of the stereograph if the vertical rod is calibrated. It is, of course, necessary to be able to orient the occlusal plane parallel to the horizontal plane of the instrument with acceptable accuracy. The vertical adjustment is particularly difficult if several lateral teeth on one side of the jaw are in infraposition or supraposition in relation to the other side, and in such cases one must determine the relationship of the dental arch to suitable planes of symmetry through the head in order to ascertain the nature of the deviation more accurately (Fig. 7).

The first question to be considered when studying symmetry by this method is whether or not the center of the palate, as represented by the raphe line, is a reliable axis of symmetry. It is conceivable that the growth of the palatine process during intrauterine development does not progress at the same rate on both sides. For instance, it may happen that sometimes the left side and sometimes the right side will grow slightly more rapidly and that consequently the

raphe line will be obliquely oriented in relation to the "true" plane of symmetry of the maxilla. Nor is it impossible that one side will present a systematic predominance and thus result in an average oblique orientation.

An impression of the reliability of the raphe line as the plane of symmetry might be obtained from the relationship between the raphe line and the dental arch in cases of nearly ideal or anatomically correct occlusion. Among 139 13-year-old boys there were twenty-eight (about 20 per cent) with such dentitions. The relationship between the raphe line and the center of the upper

Fig. 7.—Vertical asymmetry of the occlusal plane (rotation in the frontal plane).

dental arch was determined at the central incisors and at the first permanent molars. Measurements were made of the transverse distances (perpendicular to the raphe line) between the raphe line and (a) the contact point between the central incisors and (b) the mesiopalatal cusp tip of the first molar on the left side or (c) the corresponding point on the right side. The relationship between the center of the dental arch and the raphe line at the first permanent molars was then expressed as $\frac{(b - c)}{2}$. The values obtained for the two pairs of teeth are shown in Fig. 8.

It is evident that, as a rule, the difference between the center of the arch and the raphe line is small. In those cases in which there is an obvious deviation it is naturally difficult to say whether it is the raphe line or the dental arch that is asymmetric. The case illustrated in Fig. 9 seems to show that there are occasions when the raphe line is probably primarily responsible for the discrepancy.

From the clinical aspect, the analysis of symmetry has been recommended by many authors right from the time that Grünberg,[10] in the German edition of Angle's *Malocclusion of the Teeth,* showed how such analysis could be used for determining unilateral migration of the teeth, especially in the lateral regions.

Fig. 8.

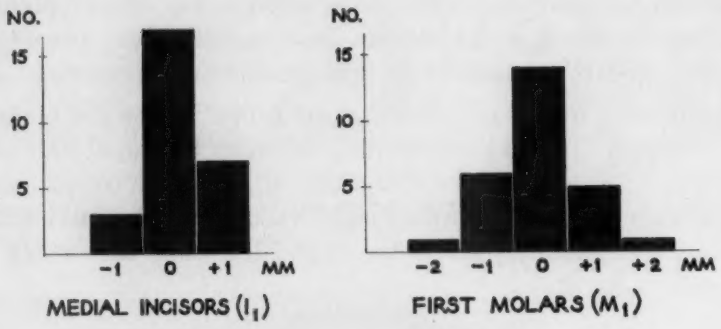


Fig. 9.

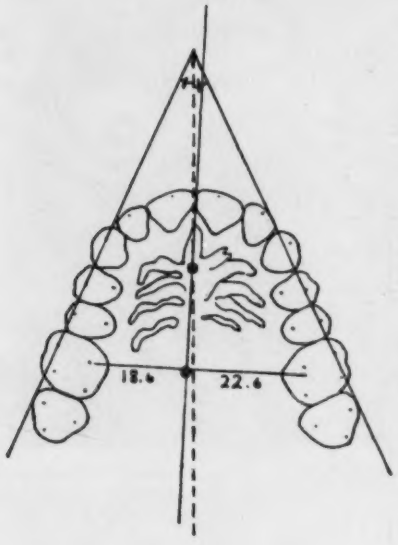


Fig. 10.

Fig. 8.—Relationship between raphe line and midpoints of the dental arch at 1 | 1 and 6 | 6 in twenty-eight cases of good occlusion.

Fig. 9.—Relationship between raphe line and dental arch center (bisector of angle between lines connecting mesiobuccal cusps of 6 | 6 and buccal cusps of 4 | 4) in a case of good occlusion and an unusually large angle between the two midlines.

Fig. 10.—Marked "S" curve of raphe line makes symmetry analysis from this line unreliable.

With regard to the findings in the investigation just referred to, such recordings cannot be considered strictly reliable. Recorded asymmetries in the anteroposterior or lateral direction must be assumed to be due, in part, to asymmetry of the raphe line. The limited value of the raphe line as an axis of symmetry is, of course, particularly obvious when it is not straight but S-shaped (Fig. 10). Even when there is no manifest irregularity, the raphe line may still be slightly oblique or S-shaped.

In addition to the normal cases, the whole series of 139 boys was examined for asymmetry in anteroposterior and lateral position of the central incisors, first premolars, and first molars. The asymmetries in the lateral direction were measured by Hunter. The results are shown in Fig. 11.

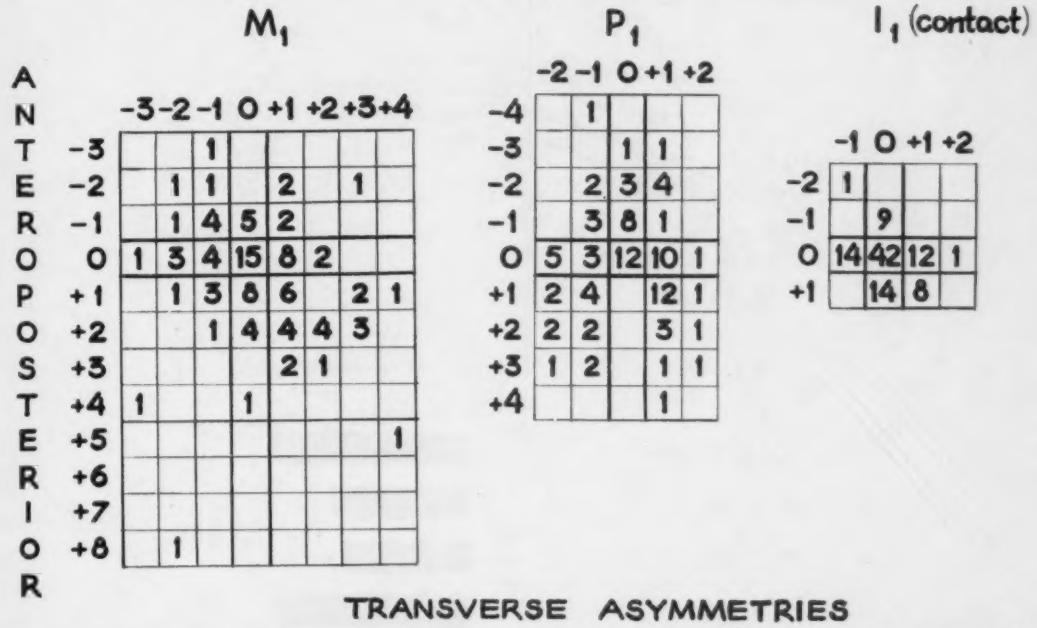


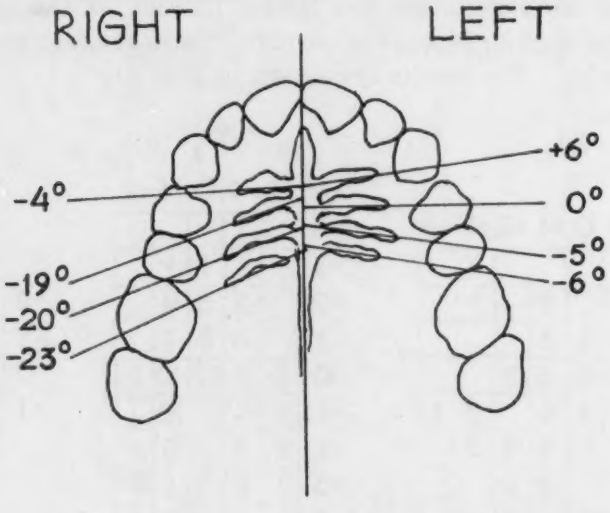
Fig. 11.—Anteroposterior and transverse asymmetries as regards the position of first molars *(M_1)*, first premolars *(P_1)* and central incisors *(I_1)* measured in milliliters from the median raphe. Positive values denote that left side is more distant from raphe line, or more anterior than right side.

It should be observed that the transverse asymmetry of M_1 and P_1, on the one hand, and I_1, on the other hand, are not directly comparable. In the case of the central incisor the position of the contact point (midpoint) was recorded in relation to the raphe line, while for the other two teeth the asymmetry was expressed as the difference between the distance of the left and right sides ($D_l - D_r$) from the raphe line. For an equivalent recording on the same scale, the previously mentioned expression $\frac{(D_l - D_r)}{2}$ ought to be used.

The greatest values for asymmetry lie clearly at M_1; this may reflect the greater tendency for migration of the M_1 than of the other teeth after early loss of deciduous teeth. It is remarkable that the M_1 on the left side is more often anterior to the same tooth on the right side than vice versa. The average

difference is 0.45 ± 0.14 mm., which is significantly different from zero. In spite of this, the finding might still be regarded as due to chance. There are, however, other circumstances which suggest that the anatomy of the maxilla is not, on the average, wholly symmetrical and that the results are not so simply interpreted. In the first place, mention might be made of Lysell's[21] study of the rugae palatinae (Figs. 12 and 13), showing that the rugae on the right side are directed more outward-backward than the rugae on the left side.

Fig. 12.



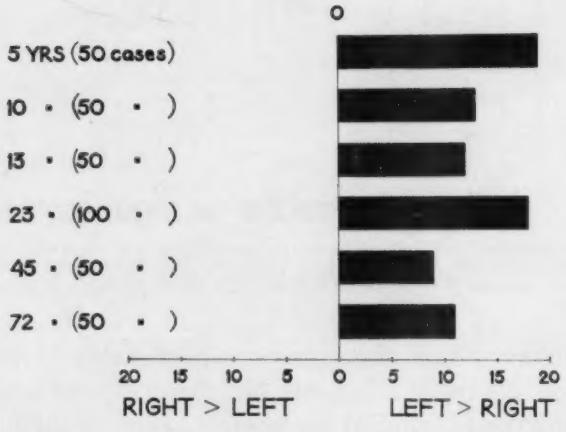


Fig. 13.

Fig. 12.—Mean direction of palatal rugae in 100 patients 23 years of age. *0* = an angle of 90 degrees from raphe line. (After Lysell: *Acta odont. scandinav.* **13**: 5-137, Supp. 18, 1955.)

Fig. 13.—Mean difference between right and left sides in the angle between the second ruga and the raphe line in different age groups. (After Lysell: *Acta odont. scandinav.* **13**: 5-137, Supp. 18, 1955.)

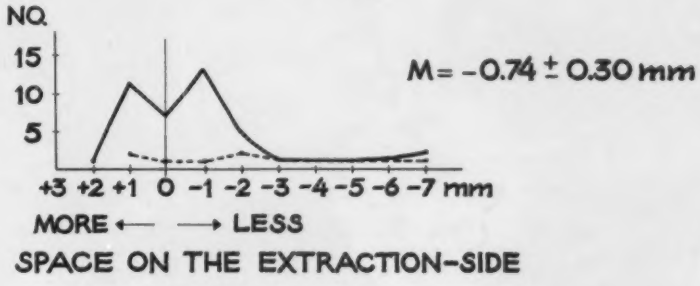
Asymmetries of the lower arch are similar to those in the maxilla. The absence of a line of symmetry, such as the raphe line, complicates the study of the differences between the right and left sides in the mandible. However, I would like to return to this question later on.

The reason for any difference between the right and left sides with respect to a supposedly genetically symmetrical organ might, first of all, be sought in the

influence of the *external environment.* As regards asymmetry of the dental arches, there are obviously a number of factors of this type that might be responsible. These include (1) finger-sucking and similar habits, (2) asymmetric chewing habits, (3) loss of contact points through dental caries, (4) extraction of deciduous teeth, (5) extraction of permanent teeth, and (6) trauma.

Some of these factors have been studied, and their influence has been demonstrated to some extent. Time does not permit a survey of the literature, but one or two diagrams might serve as illustrations (Figs. 14 and 15).

Fig. 14.



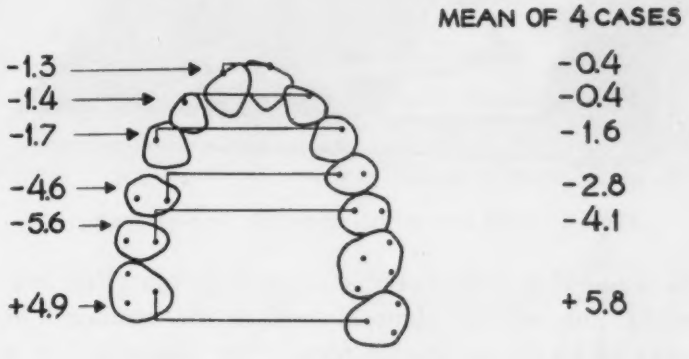


Fig. 15.

Fig. 14.—Asymmetry in crowding in cases of early unilateral loss of deciduous molars. Dotted line denotes cases for which the loss occurred before school age (in Sweden children start to school the year that they are 7 years of age). (From Linder-Aronson: *Acta odont. scandinav.* **18**: No. 2, 1960.)

Fig. 15.—Anteroposterior dental arch asymmetry in some cases of early unilateral loss of the first permanent molar.

Moreover, it should be mentioned that some right-left differences can be linked to nonspecific differences between body halves in the *internal environment.* A genetically guided symmetric development of the individual can thus result in small differences between bilaterally located organs that cannot be ascribed to the influence of any external environmental factors. In other words, the precision in the genetic guidance, though extremely high, is not perfect even if the external environment favors a symmetrical development.

As already pointed out, we must also take into account the possibility of genetic influences in the causation of some right-left differences (for example, the systematic difference in rugae direction).

The next point of interest is the degree to which the whole maxilla is symmetrically positioned in relation to the rest of the skull. An examination of this

requires the construction of a plane of symmetry through the skull. In view of the importance of the Frankfort horizontal plane in anthropology, and also because of its suitability for mensuration, the bimeatal axis may be chosen for this purpose. The reference points are then taken as the uppermost points of the external auditory meatus. A study of this type is best performed on skulls by a method such as the one described in the paragraph that follows.

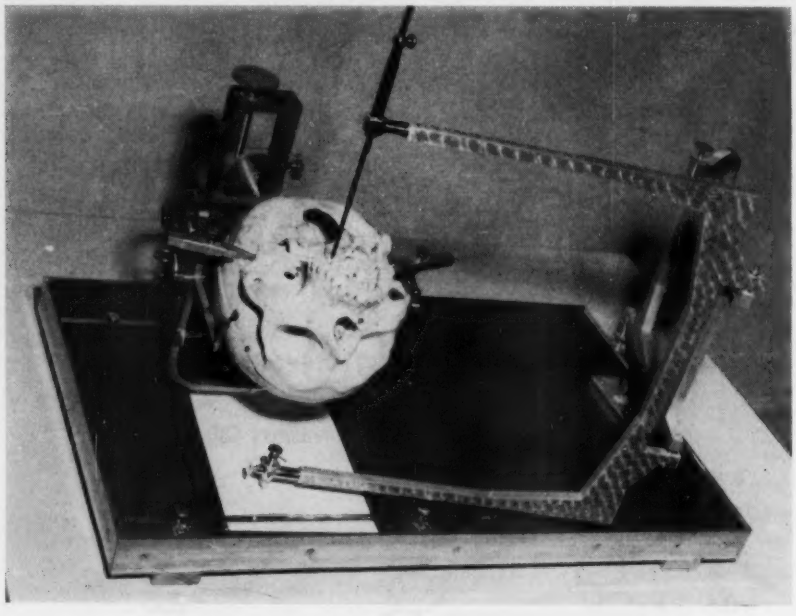


Fig. 16.—Skull stereograph according to Schwarz.[29]

The skull is mounted in a Schwarz[29] skull stereograph (Fig. 16), care being taken to ensure that the occlusal plane, defined in the manner I have already mentioned, is parallel to the horizontal plane. By means of the stereograph, the raphe line, the contact points of the teeth, the anterior and two posterior limiting points of the apical base, and the highest points on the external auditory meatus are projected on a sheet of paper. For the apical base, moreover, the vestibular and lingual limits are determined by projecting the apical base points vestibularly or lingually to the root tips of all the teeth (Fig. 17).

A study of this type requires the use of skulls that are in good condition, with full or nearly full dental arches. The material that I used consisted of twenty-nine skulls; most of them were from the Middle Ages, but there were also some from the Stone Age (about 2,000 years B.C.). The material, though small, is still sufficiently large for a pilot study.

The pronounced abrasion found in many of the skulls meant that the cusp tips were not suitable as points for defining the dental arch, and the contact points were used instead. The recording of the contact points, however, involved an element of uncertainty, since proximal abrasion had generally resulted in flat contacts between the teeth. I reduced the risk of measurement errors in

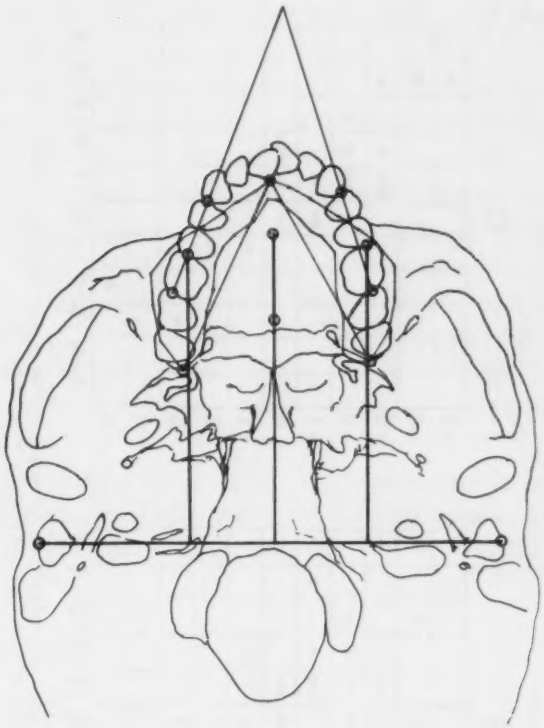


Fig. 17.—Measuring points used for assessing skull asymmetry of orthodontic interest.

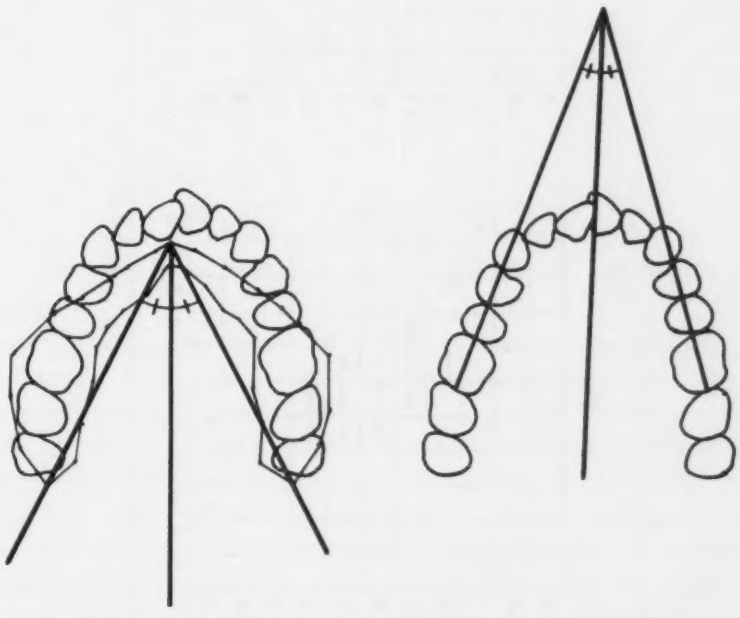


Fig. 18.—Definition of apical base center and dental arch center used in the skull examinations.

Fig. 19.—Correlation between first and second measurements in double determinations of angle between ear line and raphe line (*A*), apical-base center (*B*), and dental-arch center (*C*). (0 = 90 degrees.)

this and other measurements by making duplicate determinations. Two separate orthogonal projections were performed for each skull, and they were measured separately.

The comparison of the dispersion for the raphe, the center of the apical base, and the center of the dental arch was made on the basis of measurements of the angles between the line joining the two ear points and (1) the raphe line, (2) the apical base center, and (3) the center of the dental arch.

The center of the apical base (Fig. 18) was defined as the bisector of the angle formed when lines are drawn on the tracing from the anterior center of the apical base in the median suture, on a level with the root tips of the central incisors, to the points of the posterior limit of the apical base on the left and right sides. As posterior reference points, the most posterior points of the alveolar processes where these form contacts with the pterygoid processes of the sphenoid bone were used.

The center of the dental arch (Fig. 18) was similarly constructed as the bisector of an angle, namely, that formed by the extensions of the lines connecting the projection of the contact points of M_1 and M_2 and of C and P_1 on the left and right sides.

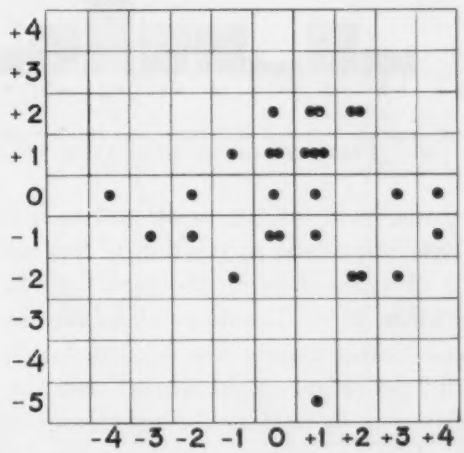


Fig. 20.—Correlation between the angles ear line to raphe and ear line to apical-base center. (0 = 90 degrees.)

The accuracy of measurement of the three angles can be illustrated by a correlation diagram (Fig. 19). The following slide shows that the duplicate measurements of the angles were usually in a pretty close agreement. The recorded measurements can therefore be regarded as fairly reliable expressions of the characteristic degree of symmetry of the skulls. It should be pointed out, however, that it is not possible to determine reliably the secondary postmortem deformation of the craniums. Nevertheless, there is probably no reason to expect any change in the raphe plane in relation to the center of the apical base. If, therefore, a primarily good symmetry of the maxilla in relation to the ear line were changed after death to asymmetry, there would be a correlation between the angles expressing the relation between the center of the raphe, the apical base, and the dental arch to the ear line.

Fig. 20 illustrates the relationship between the centers of the raphe and apical base and the ear line. Since there is no evident correlation, it would seem that there is no reason to suspect that postmortem rotation of the maxilla in relation to the cranial base is, to any appreciable degree, responsible for the recorded asymmetry. This does not, of course, mean that a closer examination of this question is not desirable.

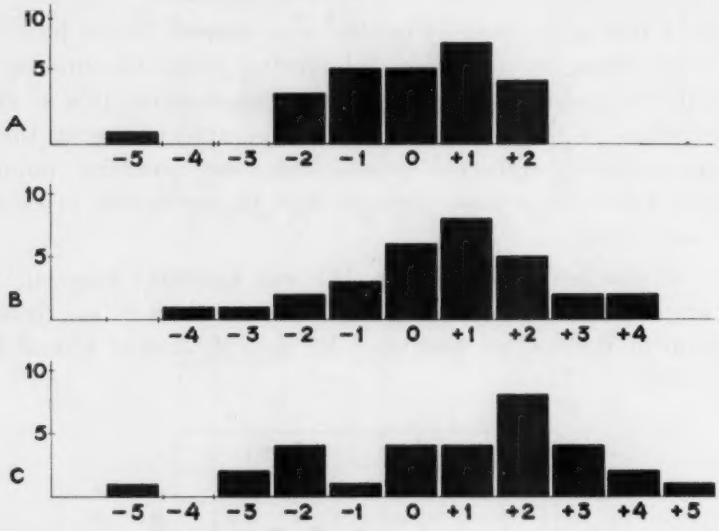


Fig. 21.—Distribution of the angles between the ear line and raphe line (*A*), apical-base center (*B*), and dental-arch center (*C*). (0 = 90 degrees.)

What is the magnitude, then, of the positional variation of the maxilla in relation to the cranial base, expressed in relation to the ear line? This problem can be illustrated with a diagram showing the variations in the angles measured for the skulls examined (Fig. 21). The dispersions for the ear line—raphe line and ear line—apical base center angles are equally large, while for the angle between the ear plane and the center of the dental arch the dispersion is slightly greater. This is probably due in part to the greater error of measurement incurred in recording the last angle, as is evident from the greater difference between the double determinations for this than for the two other angles. If 99 per cent of the true dispersions (that is, the dispersions present after the variation due to the error of measurement has been eliminated) are included for the angles, the following confidence intervals are obtained:

Ear line—center of raphe	–3.5 to +3.5 degrees
Ear line—center of apical base	–3.4 to +3.4 degrees
Ear line—center of dental arch	–5.9 to +5.9 degrees

These rotations could, of course, result in the molars being at different anteroposterior levels on the left and right sides, and subdivisions in Angle's Classes II and III could consequently be due in part to an asymmetric orientation of the upper dental arch within the skull, provided that the structure of the mandible does not show corresponding asymmetry.

In order to determine more accurately the degree of asymmetry of the anteroposterior position of the first permanent molars, I measured the distance between the ear line and the mesial contact points of the first permanent molars on the right and left sides and determined the difference between these two measurements (Fig. 22). The dispersion, expressed as the 99 per cent confidence interval, after elimination of the measurement error will be from +4.2 to –4.2 mm. It should be pointed out that there was probably no migration owing to loss of deciduous teeth, since the caries frequency in the material was particularly low. Nor was crowding observed at the second premolars. The asymmetry found need not, of course, be due solely to differences in the relation of the teeth studied to the "true" plane of symmetry of the skull, for they may also be due to the fact that the ear line shows some variation in relation to the same hypothetical plane. However, even if only a part of the variation were due to deviations in the symmetry of the maxilla, it would, in combination with the corresponding asymmetry in the mandible, be sufficient to explain the occurrence of a unilateral postnormal or prenormal occlusion.

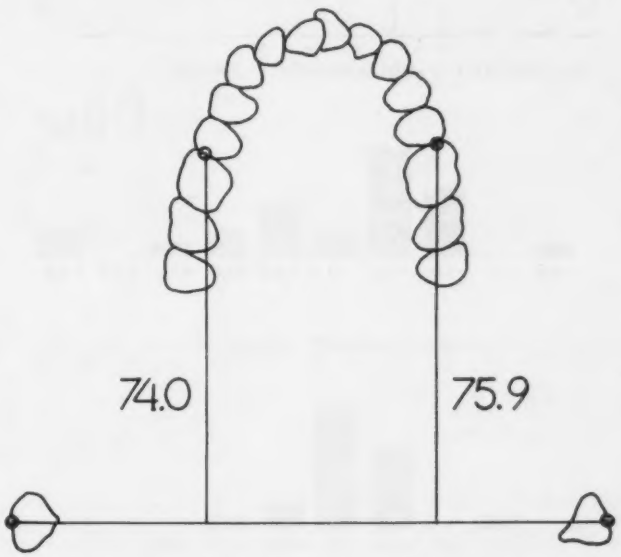
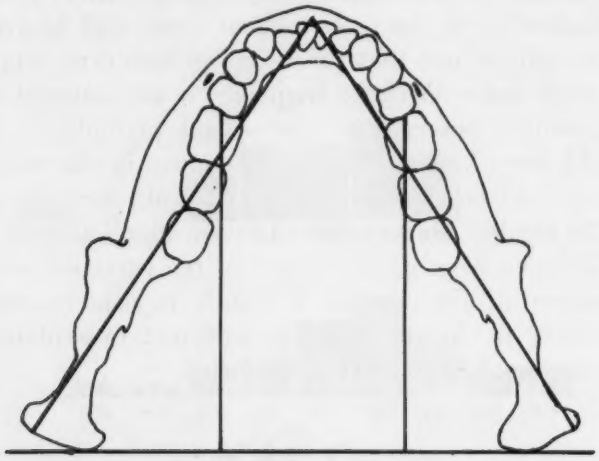


Fig. 22.—Anteroposterior difference in the position of the upper first permanent molars as measured from the ear line.

We must next consider the asymmetry in the lower jaw.[3, 38] Of special interest in this connection are the differences between the right and left sides with respect to, for instance, the distance between the condyles and homologous points in the dental arch. Accordingly, measurement was made of the distance between a line connecting the most posterior points of the condyles and the mesial contact points of the first permanent molars in the mandible. The distances were measured parallel to the occlusal plane (Fig. 23). The following asymmetries were recorded (Fig. 24). The 99 per cent confidence interval is –2.8 . . . +2.8 mm (errors of measurement eliminated). A corresponding confidence interval for asymmetries in the distances from the condyles to a midline

point on the facial surface of the mandible just above the chin is +5.2 . . . −5.2 mm. (Standard deviation for differences between right and left was calculated to 1.9 mm. in twenty-five skulls.)

Fig. 23.



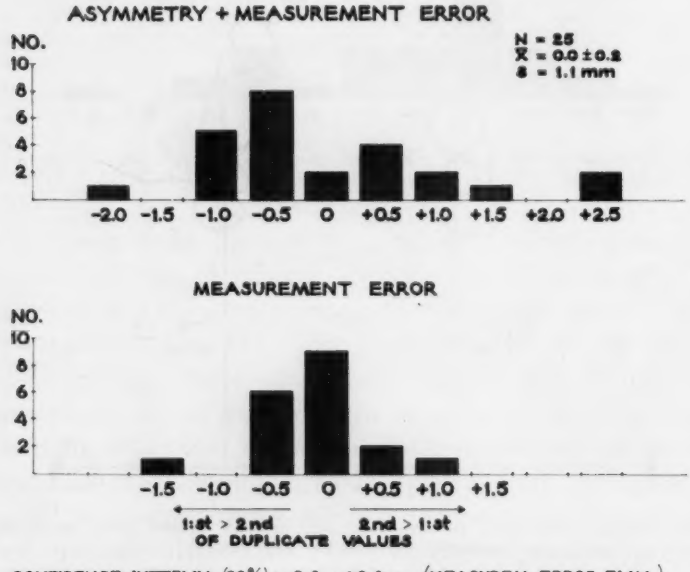


Fig. 24.

Fig. 23.—Measuring points used in assessing anteroposterior asymmetry of mandibular first permanent molars parallel to the occlusal plane and at right angles to a line connecting posterior points of the condyles. Asymmetry of the mandible was also measured as the difference in actual distances from the condyles to a midpoint above the chin between the apices of the central incisors.

Fig. 24.—Distribution of asymmetries in the anteroposterior position of lower first permanent molars (see Fig. 23).

On examining the projections of the upper apical base on the tracings, it was observed that the apical base point of the left central incisor was very often situated anterior to that of the right central incisor. A line was drawn through the two apical base points, and the angle between the line and the raphe line

was measured (Fig. 25). The mean deviation from 90 degrees was 4.2 ± 0.7 degrees; the probability that such a value might occur through chance is less than 0.001. The difference between the anteroposterior position of the two apical base points was then about 0.75 mm. The corresponding deviation for the lateral incisors was slightly lower (1.3 ± 0.5 degrees, or about 0.5 mm.). The probability of this difference being due to chance is between 0.01 and 0.02. Together with the other findings indicating systematic differences between the right and left sides of the jaw—the anteroposterior position of the first permanent molars and the directions of the rugae—this would seem to constitute convincing evidence of the presence of some systematic factor that induces a slight anterior shift of the left side of the maxilla as compared to the right side.

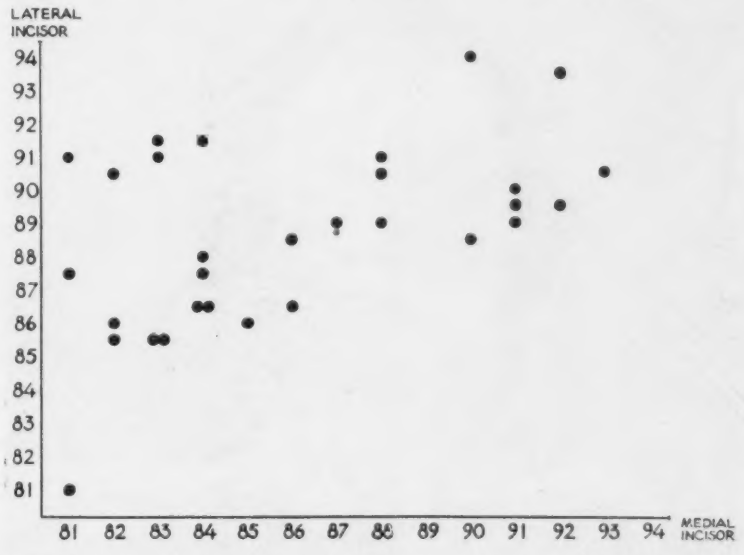


Fig. 25.—Diagram showing anteroposterior asymmetry of labial apical-base points at the central and lateral incisors, measured on tracings as angles between the raphe line and lines connecting points on right and left sides. Angles of less than 90 degrees denote that left side is anterior to right side and vice versa.

In this connection, certain other asymmetries of the skull, reported by Woo[35, 36] and by Pearson and Woo,[22] might be mentioned. The malar, occipital, and sphenoid bones were found to be larger on the left side than on the right side, while the frontal, temporal, and parietal bones showed an opposite difference. Other significant differences between the two sides of the cranium were also found; for example, the internal length of the skull was larger on the right side than on the left side.

I have so far been concerned with quantitative forms of asymmetry that can be considered as more or less normal. There are also, however, quantitative right-left differences in the facial skeleton that must be regarded as definite anomalies. Among these are the secondary deformations in the facial skeleton in cases of cleft palate, which have been studied by Harvold.[12] In such cases Harvold found, for instance, that the nasal spine usually shows a marked shift from the midline toward the defect side.

Other anomalies that are essentially quantitative in character are facial hemiatrophy and hemihypertrophy.[1, 23-28] The former (Fig. 26) is characterized by a pronounced underdevelopment of one half of the face, in which a sharp line of demarcation can sometimes be seen between the normal side and the more or less shrunken side. In the first place, the maxilla and the zygomatic bone are involved by the anomaly, for it is in these regions that the underdevelopment is most marked. The mandible, too, can present definite symptoms of this condition, just as the musculature and skin of the face can. The anomaly is of a progressive type and, according to histories, is often not noticeable until several years after birth.

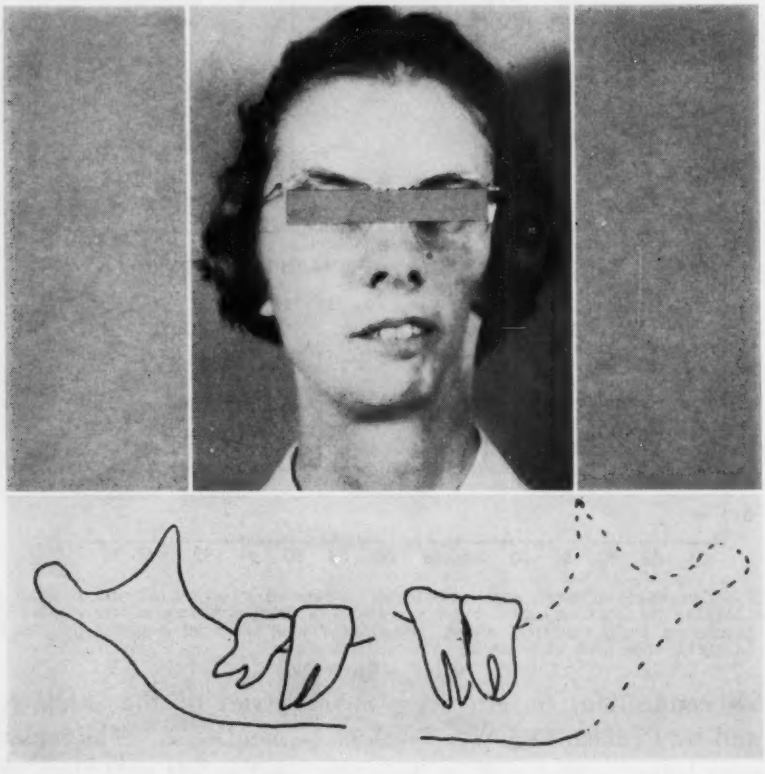


Fig. 26.—A case of facial hemiatrophy.

Facial hemiatrophy should be distinguished from the unilateral form of mandibulofacial dysostosis[2, 8, 9, 23, 34] (Fig. 27), which is a congenital deformity and can be distinguished by underdevelopment of the mandible, malformation of the external ear and atresia of the external auditory meatus, macrostomia, possible blind fistulas along a line from the angle of the mouth up to the ear, a special form of the eyelid, and heterochromia of the iris. This anomaly can also vary to a marked degree within a family. This may be due to a variable expressivity or power of manifestation of the responsible gene.

Facial hemihypertrophy (Fig. 28) is essentially a direct opposite to facial hemiatrophy. One half of the face shows a marked overdevelopment, with

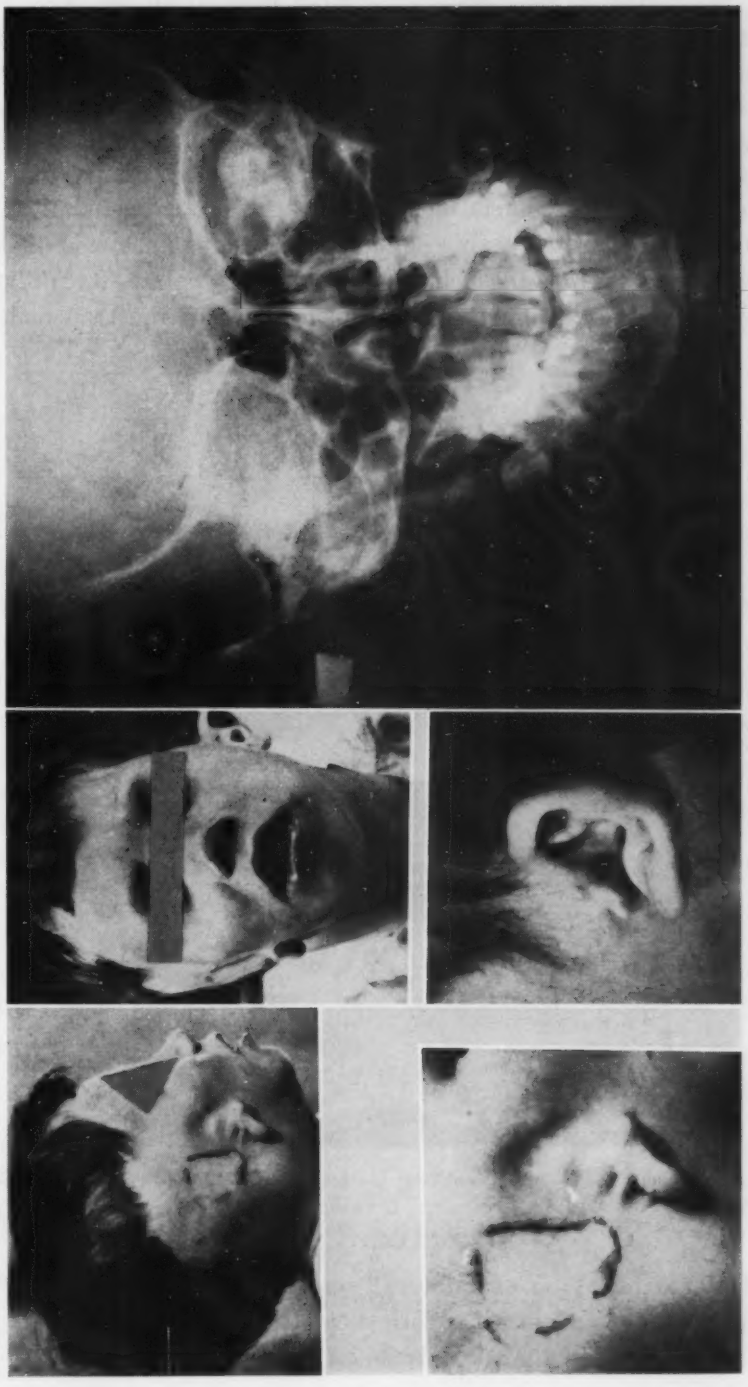


Fig. 27.—A case of mandibulofacial dysostosis.

enlargement of the maxilla and the zygomatic bone, the ear, and even the tongue and some of the teeth. The teeth also erupt prematurely in the overdeveloped half of the face. One of this anomaly's most interesting traits is the great difference in size of certain teeth on the normal and malformed sides. This might be due to a genetic difference between the two sides within the zone of growth that determines the differences in development. Such a difference might occur through, for instance, somatic mutation or genetic disorder in somatic cell divisions during the intrauterine development. We cannot rule out the possibility that in some cases facial hemiatrophy can occur in a similar manner. Cases of mandibulofacial dysostosis might be hereditary, since this anomaly has been reported to be familial. In such cases, as in cleft palate, its unilateral nature might very well be due to incomplete penetrance of the responsible genes.

Fig. 28.—Facial hemihypertrophy. (From Burke: *Brit. Dent. J.* 91: 213-215, 1951.)

SUMMARY

1. The biologic principle of bilateral symmetry is never manifested with mathematical precision, and even in fully homologous organs in the two halves of the body there are almost invariably small differences.

2. Fundamental unilaterally directed forms of asymmetry are found, especially with respect to the internal organs of the alimentary canal and the circulation.

3. Variable asymmetry can be classed as (a) qualitative, of the all-or-none type (for instance, the absence of teeth or the presence of supernumerary teeth) —and (b) quantitative, with a gradual transition from the smallest to the greatest degree of asymmetry that the organ in question can present. In both of these types one can distinguish between normal variants and anomalies. Varying asymmetry can either present, to an equal degree, left and right dominance or show a certain predominance on one side or the other.

4. From the orthodontic standpoint, the following forms of asymmetry are of particular importance:

A. Qualitative asymmetry
   (1) Number of teeth
   (2) Cleft palate

B. Quantitative asymmetry
   (1) Size of the teeth
   (2) Location of the teeth in the arches
   (3) Location of the arches in the head

5. Pronounced anomalies of an asymmetrical nature are found in the head, the most marked being facial hemiatrophy and hemihypertrophy.

6. Asymmetry can be of genetic or nongenetic origin. Among the former type are the fundamental forms for which the signals present in the inherited genetic constitution produce definite right-left differences. There are also, however, forms of asymmetry of a variable nature whose distribution is probably determined, to some degree at least, by genetic forces. A special type of such an asymmetry is the probably rare somatic mutation in which there is no inheritance of the trait by the following generations.

The nongenetic forms of asymmetry can be determined by the influence exerted by the external environment, or they may be due to random developmental differences in the internal environment of the two halves of the body.

In the case of some forms of asymmetry, the appearance of right-left differences is probably due to a combination of genetic and nongenetic influences; that is, the responsible genes display incomplete penetrance or irregular expressivity.

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STUREPLAN 19.

PRACTICE ADMINISTRATION IN ORTHODONTICS

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ALTHOUGH administration of an orthodontic practice is very similar to that of a general practice, there are certain differences.

Practice Administration for the Dentist by Mann and Easlick,[5] a workshop report, gives superb coverage of the subject. Although it does not point toward the specific problems of our specialty, the report contains much that assuredly applies to dentistry as a whole, including orthodontics.

A review of the literature indicates that there has been great interest in practice administration as it relates to orthodontics. At least thirty articles dealing with various phases of this subject have been published in the AMERICAN JOURNAL OF ORTHODONTICS during the past ten years. In addition, the matter is given sound coverage in the eighth edition of Anderson's *Practical Orthodontics.*[1]

This is true also of *Transactions of a Workshop in Orthodontics,* which was compiled in Ann Arbor, Michigan, and sponsored by the W. K. Kellogg Foundation Institute and the Education Committee of the American Association of Orthodontists. There is a gratifying demand for continued discussion.

Every act performed by the orthodontist, as by every dentist, is a matter of practice administration. Whether the act involves the appointment schedule, arrangements for examination, progress checkups, observation routine, appointment book, examination record, courtesy notices, reference cards, fees, supplies, schedule for placing appliances, treatment planning, treatment objectives, description of therapy, prognosis, cooperation, retention, interpretation of records, bookkeeping system, or accounting, it is practice administration. Insurances, estate planning, death, and legal aspects are further involved in a most important way.

Practice administration begins with the appointment schedule. Most orthodontists restrict "out-of-school" hours to short appointments, such as progress check or appliance inspection.[10] If there is appliance breakage or a loose band problem and repair or cementation cannot be attended to without making other patients wait unduly long, another appointment is made for the prompt care of this need. Included in the "out-of-school" appointment schedule are those patients who are under observation, those who are not ready for treatment,

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and those whose need for treatment is uncertain. Between these and interceptive-treatment patients, there are about forty to fifty such appointments per week in many practices.

Long appointments are given during school hours. These might vary from fifteen minutes to two hours. Some schools find that the morning is better for excusing children, while others prefer the afternoon. Whenever possible, one should fit working appointments into that schedule and never permit those appointments to become dissipated by overlapping short inspection appointments.[10]

In the building stages of a practice, the orthodontist may cater to the whims and convenience of parents. As a practice grows, there comes an awareness that it is impossible to render adequate service if all appointments are made for after-school hours or Saturdays. It is apparent that if one tried to avoid absence from school and still take care of patients in a proper manner, office hours would have to start around 3 o'clock and continue into the late evening. Obviously, this is impractical. The orthodontic result, the parents' investment in treatment, and the reputation of the orthodontist would be in jeopardy.

The original examination is followed eventually by a day of reckoning. Handling of the case must point strongly toward that day, so that it will be a happy one for all concerned. The examination appointment sets the stage and defines the "ground rules." Accordingly, it becomes the responsibility of the orthodontist to hold firm to his principles of appointment management. The patient, the parent, and the orthodontist are all better off when treatment is refused if there is an unwillingness to accept appointments that allow for proper attention to the problem.

Since it occasionally becomes necessary to cancel appointments already scheduled, there is one suggestion that applies to patients who have telephoned for an examination. This is a new name on your appointment book. It is recommended that the phone number or address be written after the name of the patient who is to be examined.

In many articles attention has been directed to the fact that some orthodontists feel that the examination should require full records, such as a health history, impressions for record models, periapical radiograms, cephalograms and photographs, as well as various analyses. It seems to me that most parents of patients coming for examination are not seeking such precise information.[6] They want to know primarily, "Does my child need orthodontic treatment, and, if so, how long will it take, and how much will it cost?" In my opinion, a simple examination form could provide those answers.

There is general agreement that a charge should be made for examinations. In some offices the parent is asked to fill out an examination form, giving the child's name, address, age, etc. Anderson[1] and Sved[10] believe in this. One feels that it is advisable to have printed on that form a statement that a fee will be charged for the examination. The other favors a form on which the stipulated examination fee is printed.

It is most embarrassing for one to attend a meeting or luncheon and have a family dentist ask what the orthodontist decided with respect to a patient

whose name the family dentist is unable to recall at the moment. Accordingly, there is an advantage to maintaining a file of reference cards, arranged according to source, revealing the name of the patient who was referred. Thus, the orthodontist may return to his office and go to the reference file with some assurance that he can find the name of the patient about whom the referring dentist was inquiring and provide an answer to the dentist's question.

It is well known that orthodontists choose to begin terminal or comprehensive treatment according to a variety of conditions. It thus happens that many patients are under observation for recall at periodic intervals. An observation file is in order. Thus, if an examination is made in January and the orthodontist desires to see the patient six months later, a postcard notifying the patient that it is time for him to return for further examination is placed in the July follow-up observation file. All the secretary has to do is go to the file at the beginning of each month, take out the cards (which are already addressed), and mail them. This takes but an instant. Some patients do not respond to the first notice, and a second notice (so designated) is sent out the following month. Since we do not wish to use high-pressure methods on our patients, a failure to respond to the second notice is followed by a telephone call to determine whether the parents desire continuation of the observation.

Most writings on the subject of practice administration have suggested the use of many records, form letters, etc. Obviously, this can be overdone, but some of these aids are essential. For instance, if treatment has been authorized, a fee letter should be mailed along with an appointment schedule. The appointment letter may be shown to school authorities as assurance that the student's absences from classes are actually for orthodontic purposes. The number of appointments needed to get treatment underway depends on the sort of appliance therapy that is being planned. Ideally, all appointments should be spaced as if the patient were the only one in the practice.

Some orthodontists prefer to reserve for a given patient the same day and hour for each appointment.[10] This plan has certain advantages; it helps the patient remember his appointments, and it may save much secretarial time. Others choose to reserve appointments on different days and hours, so that the patient will not always be missing the same classes. If the latter is the procedure of choice, it is helpful to record the date of the next appointment after the patient's name on today's appointment sheet. Thus, much thumbing through the appointment book will be avoided if the patient should misplace his appointment card and inquire as to when he is to come in again.

When the initial schedule is set up, it is wise to telephone the patient's parents before the first appointment to make sure of their intention to proceed with treatment. There will always be some who request an appointment schedule and then fail to show up or to notify the orthodontist that they have changed their minds and do not wish to undertake treatment. In such cases, the orthodontist is left with a void.

The appointment schedule must have a definite purpose. The first appointment could be for the gathering of records, such as photographs, impressions,

radiograms (both periapical and cephalometric), and other pertinent data. Separating wires might also be placed at this appointment. The second appointment could easily be the most important one, if it is used for the purpose of the case analysis.[6] Preferably, the schedule should be outlined in the presence of one or both parents, with a statement of treatment objectives, a description of therapy, and a discussion of prognosis. Remaining appointments on the schedule are for appliance construction and placement. Subsequent appointments could be used for progress checkups, appliance inspection, cavity detection, handling of diplomatic issues, periodic removal of bands for tooth inspection as indicated, and, finally, removal of appliances and placing of teeth under retention. At a later date occlusal grinding may be indicated and performed. In continuing the follow-up on completed cases, an effort should be made to take posttreatment records.

Fees for terminal orthodontic treatment,[1, 7, 10] according to habit, are usually either of the limited or the unlimited type. The limited or "flat" fee has the advantage of making it possible for the parents to know exactly what the cost will be, so that they may budget accordingly. It has the disadvantage of not providing for treatment that is prolonged beyond expectation. As a result, one who charges flat fees may accumulate a number of paid-up cases in which treatment has not been completed. A serious distraction is thus made on time that should be used for starting new cases or for attending to other necessary services. Such circumstances may result in terrific emotional strain for all concerned.

Unlimited fees protect the orthodontist against prolonged treatment. However, parents are obviously reluctant to authorize treatment on this basis. To them this looks like a unilateral arrangement. It seems reasonable that pertinent to this question is a consideration of responsibility for prolonged orthodontic treatment.

We made a study of this problem. Records of more than 600 consecutively completed cases were studied. In between 65 and 70 per cent of the patients, a result was gained in from one to two years. In contrast, treatment of the remainder lasted three to five years or longer.

What was the reason for this difference in treatment experience? Written records provided the answer. Mainly, the records revealed failure to wear elastic bands as prescribed, repeated appliance breakage, or failure to keep appointments. Thus, prolonged treatment is attributable to the patient. It is not usually the fault of the orthodontist, assuming that he makes an accurate diagnosis and completes appliance placement expertly and promptly.

The written record of treatment, accurately and fairly maintained, becomes about the most important administrative clerical obligation. I use a dictating process, in which comments concerning every appointment are dictated into a machine and then transcribed into the patient's written record by typewriter. From this we are able to detect early in the treatment whether the record that is developing is favorable for prompt completion of treatment or whether prolonged treatment will be necessary.

This has a distinct bearing on the total cost to the parents, and it has an economic impact upon the administration of our practice. Accordingly, as soon as we are quite sure that an unfavorable record is developing, we have a conference with the patient and the parents to see what can be done about it. Sometimes this will inspire cooperation on the part of the child. Perhaps, too, it will result in discontinuation of treatment altogether, with responsibility placed where it truly belongs. We acknowledge a great obligation to be watchful that investment losses to parents in a failing program are kept to a minimum.

Such conferences must be based upon fair and honest observations. The total patient is involved when we judge his cooperation[3]; so is the love of a parent for his child.

An added issue is introduced if the patient has undergone therapeutic removal of four premolars. Treatment usually may be carried through space closure with success, because not much cooperation from the patient is involved. From that point on, however, most patients will have to help themselves by applying intermaxillary elastics. If they do not follow these directions, they must be regarded the same as nonextraction patients who do not cooperate.

Most frustrating is the Class II patient who seems to be doing everything required of him, but without benefit. If his problem has remained unchanged for a year or two, is there any hope that further treatment will be fruitful? While these patients are few in number, they pose a strong challenge. Should second or third maxillary molars be extracted? Has something happened to the periodontal tissues? Is there significance to the uncommonly dense osseous tissue that may be demonstrated occasionally by roentgenograms? Is it failure of mandibular growth? Such a patient may not be dismissed on the basis of cooperation failure. Lack of response is a signal to terminate treatment as promptly as reason dictates for the good of the total patient.

Certain clerical factors are involved. These may include school excuse slips, appointment cards, the record of treatment, the bookkeeping system, income tax files, and supply lists. All of these clerical items are important and necessary.

The orthodontist's bookkeeping system must be complete and acceptable to the income tax authorities. In general, it is the same as for general practice.[5] Receipts are transferred into the record from duplicate deposit slips, on which are recorded the names of each person whose check is deposited, and from a duplicate receipt book for cash. A solid policy of issuing a receipt for all cash paid into the office must be maintained, and duplicates of these receipts should be filed away for whatever need may arise. In my practice these payments are not only transferred into the book containing the receipts and disbursements, but for each patient there is a special ledger card which is used on a duplicating machine for sending out statements as often as desired. Occasionally, a patient may request a receipt for a check. A separate duplicate receipt book is maintained for this, so that a credit may not be made twice for one payment. This book is entirely different in color, shape, and size from the one used for issuance of receipts for cash paid into the office.

The record of business expenses paid should state the date, the payee, and the check number. Various categories for income tax purposes could be stated, as drugs and supplies, salaries, auto expenses, medical journals and societies, rent, interest and taxes, light, heat, and power, postage, laundry, phone, furniture and equipment, laboratory expenses, club dues and entertainment, contributions, taxes, conventions and meetings, home telephone, petty cash, and bank charges.

As a supplement to the book in which are listed the records of receipts and disbursements, a separate file should be maintained for receipts and vouchers and other pertinent information needed for income tax purposes. Federal income tax forms for the current year, social security forms for the current year, real estate, and personal taxes are examples. In addition, files are maintained for other income, contributions, interest payments, vouchers on club dues and entertainment, and hotel receipts for conventions and meetings. There is a file for professional society dues, and another for auto expenses for the current year. Further, there should be a file in which the duplicate deposit slips and cancelled checks are placed for the current year.

Some orthodontists send their statements monthly, while others send them quarterly or semiannually. We send ours out monthly, and the duplicating machine has reduced the time spent in preparing these statements. It also eliminates the chance of error in copying figures from the ledger sheet to the statement by hand. Moreover, since the statement is a duplicate of their actual account card, the parents know at all times the total that they have paid; this eliminates a lot of inquiries from those who want to know, for income tax purposes, what they paid during a given year.

Statements are mailed in window envelopes. The new type, now available, permits clearer viewing of the patient's name and address. Stamping of statement envelopes requries considerable time, and this can be overcome by using prestamped envelopes or a stamping machine. The post office will supply stamped window envelopes. While these are adequate, there are others on the market that may be preferred.

A supply list, which will readily tell what items are ordered and from whom, is recommended. There could be a standard form describing the order and the quantities usually requested.

Of course, the matter of insurance coverage of different types is important. Dentists have been alerted to the need for malpractice insurance, and my only reason for mentioning it now is to remind you that if you have an associate in your office his name should be included in the contract.

All of us are conscious of the needs for hospital insurance, such as Blue Cross, Blue Shield, etc. These insurance plans, however, do not take care of catastrophic expenses, and many suggest that they be augmented by the type of insurance appropriately aimed. This insurance is available to certain groups, such as faculties of universities and associations of the professions.

As pointed out by Mann and Easlick,[5] health and accident coverage is another insurance in which a good administrator will be interested. It should

be pointed out that group plan health and accident policies are, generally speaking, less expensive than those subscribed for singly and privately. For instance, the American Dental Association's group health and accident insurance policy has a premium under $70.00 annually for a given age, while the premium for similar health and accident insurance that is taken out under a nongroup policy for the same monthly coverage and the same age is close to $200.00 a year. Most of the health and accident insurance policy premiums are not deductible for federal income tax purposes. Nor are indemnities received in this category to be included in the record of income.

In some states there are business expense disability indemnities which will cover office expenses to the limit of $1,000.00 a month. The semiannual premium on such an insurance policy is around $110.00, and the premiums are deductible from federal income tax. Income from this policy must be reported.

While the matter of life insurance is not primarily a question of practice administration, it does have some bearing on it. All loans, liens, or mortgages which encumber the orthodontist should be secured by the least expensive insurance available. Generally, this is known as term insurance. Of course, the object is to protect the orthodontist's survivors in the event of his death while such liens, mortgages, and loans are in effect.

As time goes on, the orthodontist may wish to increase the savings aspect of his insurance policies by converting them into ordinary life or retirement endowment policies which have the effect of enforcing discipline in a systematic savings program. It should be remembered, however, that in periods of inflation insurance properties do not keep abreast of other property investments. During the time one holds such insurance properties it is advisable to insure the premiums against accident, sickness, or business handicaps which may reduce business income to a low level. Furthermore, the insurance policies may be given riders providing for automatic loans to pay premiums on each policy in case one forgets to pay a premium, goes on a vacation, or goes into a coma.

When death comes to the orthodontist,[2, 7-9] it is important that his practice be so organized that it may be disposed of with the least possible trouble for the heirs. Conceivably, there could be claims against the estate by parents of patients. It also may be desirable to retain the services of the orthodontist's secretary until uncollected accounts are received and affairs of the practice are settled. Thus, one might wish to gain the protection of other insurance coverage ear-marked for these exigencies. Claims against the estate are unlikely, but possible.

During the Workshop in Orthodontics[7] in Ann Arbor, Michigan, in 1958, Study Group VII consulted with the law school of the University of Michigan regarding fees. Apparently, there is reason to believe, in the instance of flat fees, that the orthodontist's estate might become involved in the event of his death. This involvement could be in the form of attempts to reclaim assumed unearned portions of a fee already paid or in the form of an implied guarantee of completion of treatment. To some extent, a large down payment might also be involved, particularly with respect to refunding an unearned portion of the payment.

A particularly fine study of administration as it applies to the death of the orthodontist was made by Parker.[9] Outlined briefly, some of his recommendations are as follows:

During the orthodontist's lifetime and before serious illness:

1. Follow good business procedures and keep adequate financial records.
2. Consult qualified accountants or auditors for advice and checkup.
3. Consult the attorney who prepares your will regarding your customary financial agreements with contracts to eliminate potential trouble spots.
4. Maintain adequate liquid reserves or special insurance to cover any necessary refunds.
5. Keep understandable treatment records and case histories.
6. Practice along the lines of some recognized appliance therapy.
7. Have a check list of vital information complete for your executor's information.
8. Have a will.

When death or serious illness removes the practitioner and others must settle his affairs:

1. Retain a competent attorney until the estate is settled.
2. Secure the services of an auditor to get control of the records and locate the accounts receivable.
3. Make definite arrangements to continue the employment of the principal assistant until all problems are settled.
4. Select advisors for disposal of practice—preferably two or more orthodontists.
5. Have appraisal made of physical assets in office.
6. Attempt to secure a successor.
7. Be sure that the practice responsibility is properly assumed by the successor.

An orthodontist is faced with certain legal considerations in the administration of his practice that vary somewhat from those of the dentist in general practice.[4] Law does not expect one to guarantee a good result. Sometimes injuries after treatment or lack of cooperation during treatment lead to a poor result. The patient is then judged to be guilty of "contributory negligence."

The patient, too, is protected by law, for the orthodontist has the duty of not withdrawing from the case under certain conditions. This does not mean that the orthodontist must go to additional trouble and expense when he knows that further compensation will not be forthcoming.

SUMMARY

This article has dealt briefly with certain items relating to administration of an orthodontic practice. Among these were the appointment schedule with reference to its purpose and plan, the fee pattern, clerical records, insurance, death, and legal responsibilities. We have acknowledged that most of these considerations apply equally to all dentists, with mild variations as they relate to orthodontists. Generally, this has been a reflection of opinions previously expressed by others, with an occasional thought of my own. Reference was made to the literature of the past ten years.

CONCLUSIONS

The proposition of how best to administer an orthodontic practice is more profound than an appointment routine, fees, records, insurance, and legal responsibilities. It penetrates the therapeutic aspect, and the total problem has a

critical bearing on public and professional relations. While some hint of this has been given in my comments on length of treatment, a further one is suggested in the subject of periodic band removal for cavity inspection and prophylaxis. In addition, treatment objectives,[6] linked to our limited possibilities, propose that there is much to be acknowledged and reported in this area, as well. I suggest that some future discussions on practice administration be aimed at linking it to our many therapeutic problems.

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THE ERRATIC EVOLUTION OF ORTHODONTICS

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DISREGARDING blind trial and error, what a practitioner does, be he physician, surgeon, or orthodontist, reflects pretty accurately what he thinks. In other words, his procedures reveal his concepts. It is possible, therefore, to trace the concepts that have governed our field by noting the steps taken by its practitioners. I propose to attempt this because procedures in orthodontics during the past thirty years bear witness to profound changes in concept. To set the stage, we should first look at some of the concepts that had developed before our era. We find that some of them have a remarkably modern sound.

As early as 1743 Bunion had used the term "orthopaedies" in connection with the regulation of the teeth, and through the succeeding years this term has appeared repeatedly in the writings of various authors. That it still expresses a concept of the fundamental objectives of the field is indicated by the title of the foremost German periodical which, translated, is, *Journal of Jaw Orthopedics.* By 1771 Hunter had described the growth of the mandible on the basis of animal experimentation. His many contributions entitle him to be called the "father of orthopedics."

In 1819 Delabarre complained of a prevailing ignorance of the growth of the face and advocated a special class of physicians who would devote their entire attention to treatment of the teeth and their arrangement. Extraction of the teeth for regulating purposes had been a point of controversy since the time of Hunter, who condemned it strongly. Delabarre had this to say about it:

> It is much easier to extract a tooth than to determine if it is absolutely necessary. The extraction of a tooth requires nothing more on the part of the practitioner than a knowledge of the use of tools usually employed for this purpose, while the knowledge necessary to appreciate the consequences can only be acquired by time and study.

Blandin, in 1836, pointed out the transitory nature of the alveolar process, as Hunter had done almost fifty years before. He also drew attention to the fact that the pterygoid process backs up the posterior aspect of the maxilla so that lengthening of the upper dental arch in the back causes the face to be pushed forward by growth.

In 1855 James Taylor wrote:

Read before the Rocky Mountain Society of Orthodontists, Santa Fe, New Mexico, Sept. 26, 1960.

> It should be borne in mind that a majority of teeth appear much out of place and as if they would be very irregular when they first make their appearance and yet as the jaws expand and the teeth protrude (extrude) they acquire room and take the right position. The solicitude of the parent and the apparent irregularity observable by dentists often urge something be done while "let alone" is all that is necessary. There is no part of dental practice requiring so profound a knowledge of the operation of the economy as that which results to the eruption of the permanent teeth. A mere superficial observer will be constantly led astray, inflicting at every step far more injury than benefit. That practice which takes cognizance of one or two palpable difficulties, having no reference to collateral effects which must flow from it, is not much if any short of quackery.

Angell, in 1860, was apparently the first to call attention to the significance of the first permanent molars. It was he who first called them the "keystones of the arch" and pointed to the necessity of maintaining them and all other teeth.

About 1873 Tomes reiterated what Hunter had said in 1771, namely, that teeth did not erupt through bone already prepared for them, but that, on the contrary, bone grew around them to give them support. Thus, the teeth are completely at the mercy of the lips and cheeks on the outside and the tongue within, and these two forces determine the form of the dental arches.

During the century that we have reviewed, much other work of a fundamental nature was done which was destined to have orthodontic implications. About 1838 Goodsir had applied the cell theory to the growth of bone. By 1867 Culmann and Von Meyer had worked out the mathematics of normal bone architecture which was to lead to the law of bone transformation (Wolff's law) of 1885. Owen had published his classic *Odontography,* the bible of comparative dental anatomy, in 1840 to 1845, and a number of works on histology and embryology had followed the introduction of the compound achromatic microscope.

Much of this fundamental work was not known to the dentists of the day. Formal dental training had not been instituted, and communication was extremely limited. According to the clinical writings of that period, the regulating of teeth was governed by the concept held by the individual practitioner and varied from extraction of unsightly teeth to ambitious efforts to regulate them. Treatment procedures (that is, with appliances) were as varied as the ingenuity of the men who developed them.

It was inevitable that efforts would be made to classify the various types of irregularities, and such classifications were advanced by Fox (1803), Delabarre (1819), Blandin (1836), Carabelli (1842), and Andrews (1865). All classifications were based on the appearance of the teeth, principally the anterior ones, although jaw relations as they affected such appearance were mentioned by some.

The year 1887 might be called the dawn of the modern era, for it was in this year that Isaac B. Davenport published his paper entitled "The Significance of the Natural Form and Arrangement of the Dental Arches of

Man with a Consideration of the Changes Which Occur as a Result of Their Artificial Derangement by Filling or by Extraction of Teeth." This was a fairly comprehensive statement of the principles that were, through Angle, to dominate orthodontics for forty years. Davenport insisted that normal occlusion be the end sought in regulating teeth, asserting that only in this manner could permanent results be gained. In this same year Angle published his first paper, and in 1899 he announced the classification that bears his name.

The next twenty-five years were to prove probably the most fateful in the history of orthodontics. The concept of normal occlusion and the classification of malocclusion for the first time gave the practitioner a fixed objective toward which he could direct his treatment. Whereas he previously had only his own vague ideas of what he wished to accomplish, he now had an ideal anatomic goal to which he rapidly reoriented himself with enthusiasm.

In 1900 Angle gathered around him a group of young men destined to be the first class of students of any specialty in dentistry. This was the beginning of the Angle School. With some interruptions, it continued until 1926. By 1907 the alumni of this school had reached the point where they were able to launch a journal, *The American Orthodontist,* which was published until 1912. This was the first special journal in dentistry.

From the beginning of his regulating efforts, Angle, like all of the other early workers, had designed and fabricated his own appliances for each case. He was always seeking better and simpler ways of doing things, however, and eventually he began to experiment with devices that had general uses. One of the earliest of these was the molar clamp band which he had designed previously for management of jaw fracture. Equipped with tubes and a piece of heavy nickel-silver wire, this appliance had the essentials of all the buccal expansion devices that had gone before. Furthermore, its parts could be manufactured and kept in stock by dealers, thus fulfilling the prophecy that Farrar had made in 1873. This was the "E" arch, which was to be completed by the McGill band for teeth other than molars and subsequently by the rubber intermaxillary elastic. This appliance had all the properties necessary for treatment by expansion which, until the introduction of the classification, had been the principal objective of the orthodontist.

The Angle classification had a terrific impact on orthodontics, since it signalized a complete change in concept. Until this time the Class II, Division 1 case had been managed by extraction of the maxillary first premolars, followed by attempts to retract the incisors and canines. This had been done by Angle and by Kingsley before him. The latter now enthusiastically embraced the Angle classification and recognized that such extractions violated it. Accordingly, he sought to shift the entire lower dental arch forward to its correct relationship by jumping the bite. He did this by means of a steep metal inclined plane fastened to the maxillary incisors. Angle adopted the same method for a time, but both men found that in such cases the former condition returned following treatment.

It was around this time that Baker introduced the intermaxillary elastic, and Angle seized upon it as an adjunct to his appliance. Pitting the resistance of the two jaws against each other, he sought to tip the teeth of the mandible forward while maintaining the upper teeth in upright positions. He did this because he was convinced that the Class II case was characterized by a distal position of the lower arch. As might be expected now, he did not succeed.

Angle next sought to compromise by tipping the lower teeth forward part of the way and the upper teeth backward part of the way in order to arrive at normal interdigitation which he hoped would be followed by an uprighting of the teeth of both arches through normal function. This proved partially successful; the upper teeth uprighting themselves but the lower teeth remained tipped. Angle then tried carrying the upper teeth back the entire distance to their normal relations with the lower teeth, and now he began to have success.

Although the results obtained with the "E" arch were a marked improvement over any that had been obtained prior to that time, they were not uniformly successful. Working with only simple tipping forces, Angle found that in many cases there was an unpleasant prominence at the end of treatment. Finally, one such case caused a radical change in his thinking. This was the case of a girl who, at the end of treatment, had what is known today as double protrusion. This caused Angle to ask himself whether or not he should have extracted four premolars. The girl moved away and was not seen again until several years later, at which time Angle was amazed to find that, although the occlusion had remained unchanged, the denture had lost all signs of its former prominence. He concluded that normal function had uprighted the teeth, and he wondered why the orthodontist could not do the same thing during the retention period. His first attempt at this was apparently successful; it involved banding the four upper incisors and providing them with tiny vertical tubes which received parallel pins running gingivally from the arch wire. This was in 1909.

By 1911 Angle had applied this principle during the treatment phase of management with the development of his pin-and-tube appliance, and at the meeting of the Angle Society that same year he read a paper entitled "Bone Growing." At the same meeting Oppenheim presented the results of his classic studies entitled "Tissue Changes, Particularly of the Bone, Incident to Tooth Movement."

Oppenheim showed that the changes in the alveolar bone subsequent to the application of orthodontic forces followed the dictates of Wolff's law: "Every change in the form or function of a bone, or of its function alone, is followed by changes in its internal architecture and secondary alterations in its external conformation in accordance with mathematical laws."

Putting the clinical and experimental findings together led to what I shall call the concept of functional development, which had already been embraced by the orthopedist and which was now to govern orthodontics pretty generally for the next twenty-five years. Briefly, this concept held

that if teeth were placed and held in correct occlusal relations, not only would vigorous, normal function maintain them but the supporting bone of the jaws would grow to supprt them. Immediately all sorts of claims were made (for example, that widening of the maxillary arch resulted in widening of the nasal passages and that weak mandibles could be made strong). One man even told me that physicians were sending him patients for arch widening to enlarge the sella turcica.

Angle continued to seek improvement in his bodily movement appliances. The pin-and-tube appliance was proving too demanding for all but the most meticulous workers. Angle's answer was the ribbon arch, which was introduced in 1917. I shall not take time now to describe this appliance, but I should like to mention one way in which it resembled the pin-and-tube appliance. This was in the manipulation of the arch wire.

The "E" arch had come from the manufacturer in different sizes but already formed. During treatment teeth were drawn toward it by ligatures. Thus, it constituted something of a limiting factor which was advantageous. With the advent of bands carrying vertical tubes, it became necessary for the operator to modify the form of the arch to make it follow the contours of the individual teeth and permit the simultaneous seating of the pins. Treatment consisted of gradually ironing out the arch by gentle smoothing bends.

Because the ribbon arch bracket and arch fit each other with very narrow tolerance, this adapting of the arch to the malocclusion was carried over to the new appliance and the limiting factor was lost. The operator's judgment took its place, frequently with grotesque results. The arch was bent in any manner that would permit alignment of the teeth, and such alignment frequently led to an arch form resembling the three straight segments of the gorilla's. In addition, there was no control over the premolars, since the arch had to be seated horizontally in the molar tubes and vertically in the anterior brackets.

It will probably surprise some readers to learn that the edgewise arch bracket was first employed as an adjunct to the ribbon arch appliance. These brackets were used on the buccal teeth, and the arch was twisted 90 degrees at the interproximal space between the lateral incisors and canines. Now the arch could be seated horizontally in the buccal brackets.

Before long, Angle realized that the use of similar bands on the anterior teeth would facilitate application of the arch. He thereupon advocated the placing of bracket bands on all teeth, and the edgewise arch became an appliance system in its own right.

At first the arch was made to conform to the positions of the individual brackets, as had been done with the ribbon arch, a tedious process at best. This necessitated the gradual re-forming of the distorted arch to one that represented the operator's idea of normal, and Angle had scant respect for the average practitioner's idea of a normal dental arch form.

Now the search was on for the dimensions and form of a pattern that would constitute not only a guide but also a limiting factor, such as the

preformed "E" arch had been years before. Studying normal dentitions from skulls and living persons, Angle quickly came to recognize the individuality of each. The tailor-made "ideal arch" was the result. With this, only the typing of the arch was left to the operator.

The immediate placement of the ideal arch at the beginning of treatment was impossible, however. The alternatives were either to revert to the tipping principles of the "E" arch or to resort to lighter arch wires that could be sufficiently distorted to permit their being woven into the brackets. Angle chose the latter, but it should be noted in passing that he never employed any material other than that used in the gold ideal arch.

Many of Angle's followers, noting how nicely such light forces worked, began to use either lighter wires or wires with high degrees of resiliency, such as steel. These worked with great speed and thus were hailed as a boon. If function would grow bone to support teeth in correct occlusal positions, then the quicker such positions were gained the better. Now, however, cases began to go out of control through the abuse of anchorage. Fortunately for him Angle died before he saw the results of this.

THE IMPACT OF GROWTH STUDIES

Although many excellent studies on growth have been conducted during the past 150 years, they have been completely ignored by those members of the healing arts whom one would expect to be most vitally interested in them, namely, the pediatrician, the orthopedist, and the orthodontist.

As was mentioned earlier, John Hunter had accurately described the growth of the mandible by 1771. His contention that the ramus grew backward and was resorbed on its anterior border was proved by Humphreys around the middle of the last century; it has recently been further verified. Brash carried his investigations into the upper face. Both Hunter and Brash wrote extensively on the behavior of the teeth during their eruption.

In contrast to the qualitative methods employed by the above-mentioned men, which involved vital staining, Todd, Hellman, Krogman, and others have employed quantitative methods, that is, they have made direct measurements.

Finally, through the introduction of roentgenographic cephalometry, it became possible to measure the growth of the same living person through the period of growth, something that had been impossible before. This last technique gave rise to the pattern concept, which holds that the proportion of parts of the head change very little with growth. This is in contrast to the previous view that the relation of the face to the rest of the head changed with advancing age.

Roentgenographic x-rays also gave us a means of watching the results of our treatment, and the initial effort to do this marked the introduction of a different concept than that which had governed us previously.

In 1938 the staff of the orthodontic department of the University of Illinois published the results of a six-year study entitled "A Cephalometric Appraisal of Orthodontic Results." The sample was divided according to the Angle classification and included all cases treated during the previous six years.

Obviously, many of the finished records were those taken at the end of treatment. The findings were sobering because they showed, to our satisfaction at least, that we were doing some things that we did not suspect and failing to do much that we had thought we were accomplishing.

The finding that the establishment of excellent occlusal relations was not necessarily accompanied by changes in associated bone structures, as the concept of functional development had led us to expect, forced us to abandon this concept. But this finding had even greater effects on others in the field of orthodontics. In some quarters it was seized upon as an explanation for relapse. It was reasoned that if function would not develop sufficient bone to hold all the teeth, there was no recourse but the extraction of sufficient tooth material to make them harmonize with the jaws that held them.

If the concept of functional development was no longer tenable, however, it was obvious, to some at least, that those cases that had been treated successfully in the past had also to be explained. There were many such cases in the practices of experienced orthodontists. The answer lay before us, revealed by our cephalometric x-rays. It was the amount of growth and the degree of maturation enjoyed by the individual patient.

In other quarters, however, our findings were interpreted differently. Without the benefit of headplates, which were being taken by very few practitioners at that time, conclusions could be based only upon evidence derived from plaster models and photographs. These seemed to point, in many cases, to a lack of sufficient bone to hold all the teeth. Arches were expanded, teeth were tipped excessively, and lips were prominent. All signs pointed to the necessity of extracting teeth if they were to be in harmony with surrounding parts, and this procedure was endorsed, tentatively at first and then with overwhelming enthusiasm.

Once the propriety of this mode of treatment was accepted, new concepts followed each other in rapid succession. Without exception, each of these was a rationalization, unsupported by any objective evidence. I shall mention a few of these rationalizations:

1. The jaws of modern man are undergoing a diminution in size to a greater extent than are the teeth.
2. Teeth should stand upright over the ridge of so-called basal bone. (This was borrowed directly from full denture prosthesis. In the natural dentition there is no ridge and the axial inclination of the teeth in normal, untreated occlusions has a range of over 20 degrees. The mean of the range depends upon which plane of reference is used in the particular study.)
3. When teeth stand upright over basal bone, they are more stable because forces then travel down their axes. (It is difficult to see how incisors can transmit forces down their axes unless they meet edge to edge. Actually, the incisors transmit less force down their axes than any other teeth, since they pass each other, scissors-fashion, in function.)

4. Since the incisors should stand upright over basal bone, the profile of the face should be straight.
5. The face with the straight profile is the most beautiful.
6. Failure to obtain a straight profile with treatment constitutes failure to attain the objectives of treatment.

These last three precepts violate fundamental canons of both art and biology, namely, that there are endless forms of beauty and that there is infinite variation in all forms of life. Were this not so, there could be no evolution.

Through rationalizations such as these and others, the basic concepts governing a large proportion of orthodontic practice in this country have changed radically during the past twenty-five years. Esthetics of the face has supplanted function of the teeth as the chief objective of orthodontic treatment, tending to place the orthodontist in a class with the beautician rather than with the "physicians of the mouth."

This overzealous concern with esthetics and speed at the expense of all else is threatening the prestige of orthodontics, which has long been looked upon as the most scientific of dental fields. Parents and dentists alike are questioning the propriety of extracting so many teeth in the attempt to establish adult relations in a child's face.

Aside from the question of prestige, the dental health of our patients is another important consideration. The premature aging of the denture that seems characteristic of cases treated by extraction mainly for the purpose of straightening the profile, the deepening of overbites with the not infrequent appearance of joint symptoms, and the development of spaces at the sites of extractions all bear witness to the fact that we have not yet reached Utopia. Are present concepts helping us to get there or carrying us farther away?

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THE HABILITATION OF THE CONGENITAL CLEFT PALATE PATIENT

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INTRODUCTION

WEBSTER[1] defines the word *habilitation* as "the act of habilitating, qualification, or capacitation."

Applied to the treatment of persons with congenital cleft palate, this word seems more fitting than the term that we have habitually employed—*rehabilitation*. We are not restoring that which has been lost, for these persons have never been fortunate enough to qualify as normal, complete physical beings.

Modern medical science stresses rehabilitation of the minds and bodies of those who are casualties of war and of life itself. Certainly, there is no less feeling of accomplishment in helping to provide that which a momentarily improvident Nature failed to provide.

CAUSATIVE FACTORS

The causative factors that produce such developmental defects as cleft lips and cleft palates are well known embryologically.

The cleft upper lip is recognized as a defect located at a line where, during the second month of intrauterine development, the maxillary process should have fused with the nasomedial process. This cleft may be unilateral or bilateral, and it may or may not be accompanied by a cleft palate[2] (Fig. 1).

The defect in the jaw and in the anterior part of the palate is along the same line of fusion between the median-nasal and maxillary processes which are involved in a cleft lip. Farther back in the palate the gap is medial, being due to the failure of the lateral palatal shelves to unite with each other (Fig. 2).[2]

Recent investigations have revealed that an epithelial fusion does occur in cases of cleft lip but that the epithelial wall is not perforated by mesoderm. Therefore, the epithelial union of these processes ruptures. This explanation is borne out by the occurrence of thin strands of tissue which unite, in some cases, the medial and lateral walls of the cleft lip. These bridges develop if the mesoderm perforates the epithelial wall only in a restricted area.

The relationship of cleft jaw to the bone and to the teeth varies considerably. In some cases the cleft corresponds to the suture between premaxilla

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and maxilla; in other cases the cleft cuts through the premaxilla itself, dividing it into a medial and a lateral part. Frequently, the lateral incisor is found medial to the cleft jaw; in some cases it is lateral to it. In some instances the lateral incisor is medial to the cleft lip and a supernumerary lateral incisor lies lateral to it. In other cases the lateral incisor is missing. The explanation for this variability is that the skeletal parts appear long after fusion of the facial processes has been completed. Thus, the bones develop in a uniform tissue and with no regard for the primary boundaries between the processes.[3]

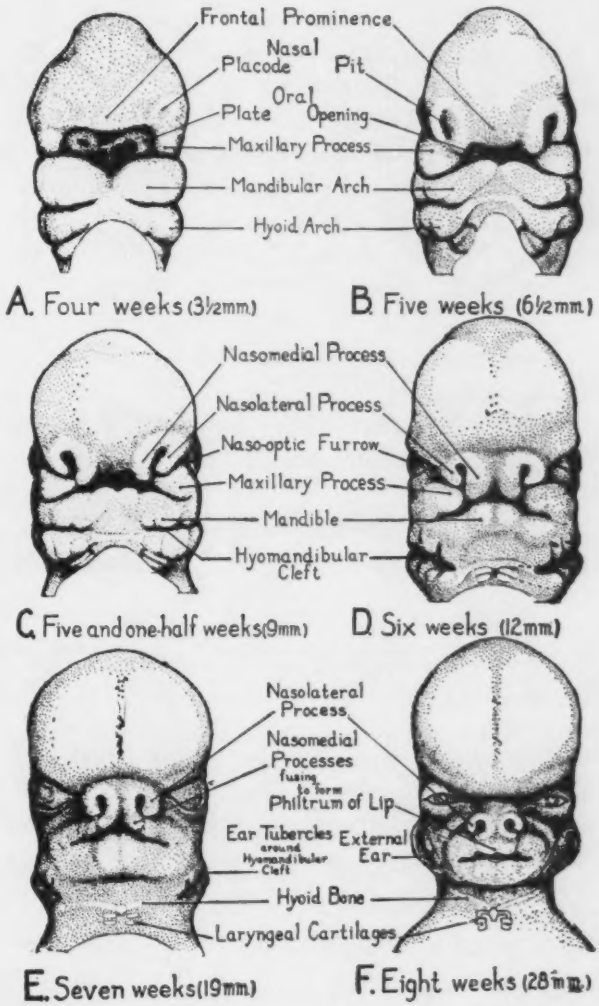


Fig. 1.—Drawings showing, in frontal aspects, some of the important steps in the formation of the face. (After William Patten, from Patten, Bradley M.: Human Embryology, Philadelphia, 1947, The Blakiston Company.)

ETIOLOGICAL FACTORS

It is far easier to understand how the clefts occur than to comprehend why they occur. Many theories, ranging from the ridiculous to the scientific, have been advanced with the accumulation of data throughout the years.

One idea based on the fact that "later life pregnancies" were responsible has no scientific support.[4] Another theory of etiology is that a peculiar position of the embryo in the second month of intrauterine life causes a diminution of the oxygen supply necessary for the fusion of the parts.[5]

Patten[2] says that the condition behaves as a Mendelian recessive trait based on a gene defect. This would seem to indicate that the condition is inherited, but the accumulating data are still admittedly inadequate.

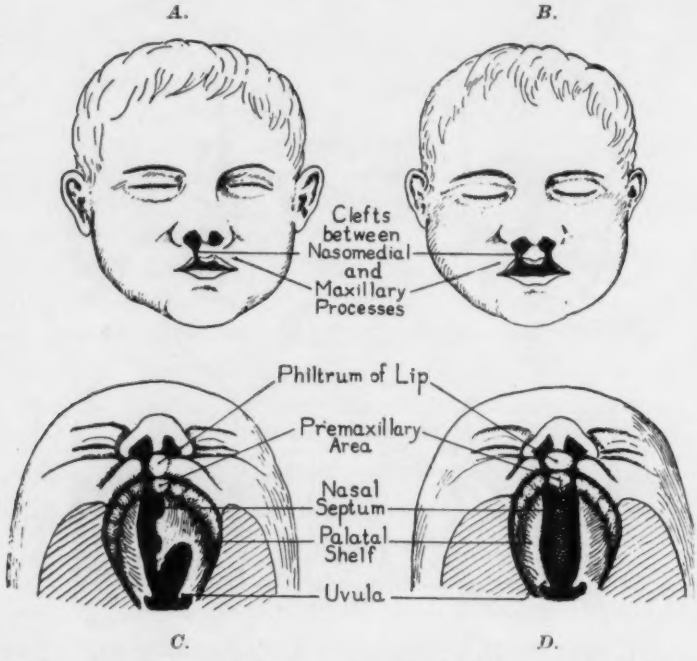


Fig. 2.—Schematic drawings showing cases of cleft lip and cleft palate. *A*, Unilateral cleft lip. *B*, Bilateral cleft lip. *C*, Palate in a case of unilateral cleft lip. *D*, Palate in a case of bilateral cleft lip. (After Corning, from Patten, Bradley M.: Human Embryology, Philadelphia, 1947, The Blakiston Company.)

In continuing attempts to disprove the genetic theory of the etiology of cleft lips and palates, Kalter and Fraser[6] have reported the results of interesting research on the production of cleft palate conditions in the offspring of mice. When pregnant mice were treated with Compound F (cortisone), congenital cleft palates occurred in 95 per cent of their offspring.

OCCURRENCE

Clefts occur without respect for cultural or economic background. Nor is there a greater occurrence in any particular race or nationality, although some claim that the Negro race exhibits less tendency toward the occurrence of clefts.

Cooper[7] states that it is now fairly well established that one in 700 persons is born with this form of nonunion, and therefore it is one of the most frequently found congenital anomalies.

Davis,[8] in his review of the cleft lip and palate problem, says that 70.83 per cent of all cases occur in males and 29.17 per cent occur in females.

He also reports that clefts occur more than twice as often on the left side as on the right side. Bilateral clefts occurred in about 16 per cent of all cases.

A report of my examination of ninety-three persons with cleft lip and palate is presented in Table I. Statistics gathered from Table I are as follows:

Female patients examined, 41 (44.08 per cent).
Male patients examined, 52 (55.92 per cent).
Oldest patient, 59 years.
Youngest patient, 4 years.
Average age, 22.9 years.
Number of patients with cleft lips examined, 71 (76.3 per cent).
Number of patients with no lip cleft, 22 (23.6 per cent).
Number of left unilateral lip clefts, 36 (49.9 per cent).
Number of right unilateral lip clefts, 13 (18.0 per cent).
Number of bilateral lip clefts, 22 (30.5 per cent).
Number of patients with cleft palates examined, 93 (100 per cent).
Number of left unilateral cleft palates, 36 (38.7 per cent).
Number of right unilateral cleft palates, 13 (13.9 per cent).
Number of bilateral cleft palates, 44 (47.3 per cent).
Number of cleft lips not surgically repaired, none.
Number of cleft palates not surgically repaired, 9 (9.6 per cent).
Number of patients who were edentulous, 6 (6.4 per cent).
Number of patients who have received orthodontic treatment, 41 (44.4 per cent).
Number of patients who have received orthodontic treatment by the author, 30 (32.2 per cent).

INTEGRATION OF SERVICES IN TREATMENT

Examination and treatment of the foregoing patients have convinced me that the successful total habilitation of the cleft lip and cleft palate patient depends on the combined efforts of a number of professional people. This teamwork aspect is best exemplified by the outstanding work being done by Cooper[7] and his associates. The cooperative effort of this group should serve as a model to all who are interested in the habilitation of these patients.

To be explicit, this team of pediatrician, surgeon, psychologist, otolaryngologist, restorative dentist, orthodontist, prosthetic dentist, and speech pathologist should approach the problem at hand together. Ideally, the finest results are obtained, as in Dr. Cooper's clinic, by an actual round-table consultation and discussion.

Cooper's graphic representation (Fig. 3) is perhaps the best explanation of the modern cooperative effort. He says: "The spoke at the bottom of the wheel is the one bearing the weight at any particular time, but all other spokes have an equally distributed load, and each in its turn at some time is the key factor. Consequently the 'when' of integration is extremely important."[7]

Since this form of attention is more the exception than the rule, the aim must be to impress each, a specialist in his field, with a desire to be tolerant of the others' views.

TABLE I

CASE NO.	SEX	AGE	LOCATION OF CLEFT*						
			LIP			PALATE			
			L	R	B	L	R	B	
1	F	17	x			x			
2	M	17			x			x	
3	F	19		x			x		
4	F	25		None				x	Hard and soft palate complete
5	F	51		None				x	Hard and soft palate complete
6	F	38		None				x	Hard and soft palate complete
7	M	28		None				x	Hard and soft palate complete
8	M	32	x			x			
9	F	6			x			x	
10	F	31		x			x		
11	M	17			x			x	
12	F	15		x			x		
13	F	46	x			x			
14	F	59	x			x			
15	M	18			x			x	
16	M	33	x			x			
17	F	39	x			x			
18	M	59		None				x	Soft palate only
19	M	32	x			x			
20	M	24		None				x	
21	F	18			x			x	
22	M	40	x			x			
23	F	34	x			x			
24	M	6	x			x			
25	M	28	x			x			
26	M	16			x			x	
27	F	15			x			x	
28	M	42			x			x	
29	F	47	x			x			
30	M	33	x			x			
31	F	17	x			x			
32	M	21	x			x			
33	F	16		None				x	Soft palate only
34	F	35		x			x		
35	M	8	x			x			
36	M	8		x			x		
37	F	20	x			x			
38	M	19		x			x		
39	M	22		None				x	
40	M	43		x			x		
41	M	17			x			x	
42	M	17	x			x			
43	F	36	x			x			
44	M	5			x			x	
45	M	4	x			x			
46	M	18		x			x		
47	F	25		None				x	
48	F	12			x			x	
49	M	25	x			x			
50	M	17		x			x		
51	M	5		None				x	
52	F	10			x			x	
53	F	8	x			x			
54	F	9		x			x		
55	F	8	x			x			
56	M	8	x			x			
57	M	9		x			x		
58	F	12	x			x			
59	F	16	x			x			
60	M	8			x			x	
61	F	14	x			x			
62	M	16			x			x	
63	F	15	x			x			

TABLE I—CONT'D

CASE NO.	SEX	AGE	LOCATION OF CLEFT*						
			LIP			PALATE			
			L	R	B	L	R	B	
64	F	30		None				x	Soft palate and one-half of hard palate
65	M	22	x			x			
66	M	27	x			x			
67	M	39		None				x	Hard and soft palate complete
68	M	33			x			x	
69	F	23			x			x	
70	M	16			x			x	
71	M	19			x			x	
72	F	21		None				x	Hard and soft palate complete
73	M	11		x			x		
74	F	36	x			x			
75	M	21	x			x			
76	M	16	x			x			
77	M	35		None				x	Hard and soft palate complete
78	F	36		None				x	Hard and soft palate complete
79	F	23		None				x	Hard and soft palate complete
80	F	42		None				x	Hard and soft palate complete
81	M	31	x			x			
82	M	25		None				x	Hard and soft palate complete
83	F	19		None				x	Hard and soft palate complete
84	M	26	x			x			
85	M	15			x			x	
86	F	28		None				x	Hard and soft palate complete
87	F	17			x			x	
88	M	11			x			x	
89	F	23	x			x			
90	M	10		x			x		
91	M	30		None				x	Hard and soft palate complete
92	M	30		None				x	Hard and soft palate complete
93	M	23			x			x	

*L = Left.
R = Right.
B = Bilateral.

The Role of Surgery.—Inasmuch as the surgeon is one of the first to be confronted with the problem of cleft lip and cleft palate in an infant, he is urged by often distraught parents to do something immediately.

The surgical classification of cleft lips, according to Holdsworth,[9] is as follows:

Lateral clefts

1. Single—Incomplete
   Complete
2. Double—Incomplete
   Complete

Median clefts

1. A notch in the vermilion border, sometimes accompanied by faint scars extending upward to the nostrils on each side of the philtrum.
2. A cleft extending in the midline toward and perhaps into the columella.
3. A similar but deeper cleft passing into the septum and palate.

Holdsworth[9] says of the nose: "Nasal deformity is present in all but the slightest cases of cleft lip, and increases the general unsightliness of these patients as well as complicating the surgery."

Fig. 3.—Graphic representation of the application of cooperative effort in the habilitation of the cleft palate patient. (After Cooper, H. K.: *J. Am. Dent. A.* 47: 27-32, 1953.)

Type I Type II Type III Type IV

Fig. 4.—Classification of palate clefts. (After Veau, from Holdsworth, W. G.: Cleft Lip and Palate, New York, 1953, Grune & Stratton, Inc.)

Veau[10] suggested a concise classification of cleft palate, as follows:

1. Soft palate only.
2. Hard palate involved, but not in front of the incisive foramen.
3. Complete unilateral cleft extending from the uvula to the incisive foramen in the midline, this deviating to one side and usually meeting the alveolus about the position of the lateral incisor.
4. Complete bilateral cleft, resembling type 3, but with two clefts extending forward from the incisive foramen to the alveolus. Should both clefts involve the alveolus, the small anterior element of the palate commonly referred to as the premaxilla remains suspended from the nasal septum (Fig. 4).

Modern surgical techniques have progressed to an amazing degree since the days of the Brophy[11] technique when the lateral maxillary segments were crushed until they were in contact, at which time they were wired tightly.

Much is being done to eliminate this type of operation, which all too often results in dismal failure and greatly hampers future surgical as well as orthodontic and prosthetic efforts to close the defect.

Brown,[12] in 1936, first described the "set-back" technique for the surgical treatment of cleft palates (Fig. 5). This technique, the variations made by the individual surgeon, and the "pharyngeal flap" operation constitute what is generally considered to be the choice of surgeons today. Brown further states that, as in any other flap-elevating operation, tooth buds may be damaged if the operation is performed too early; therefore, the elongation may be delayed until the second year or later, as desired.

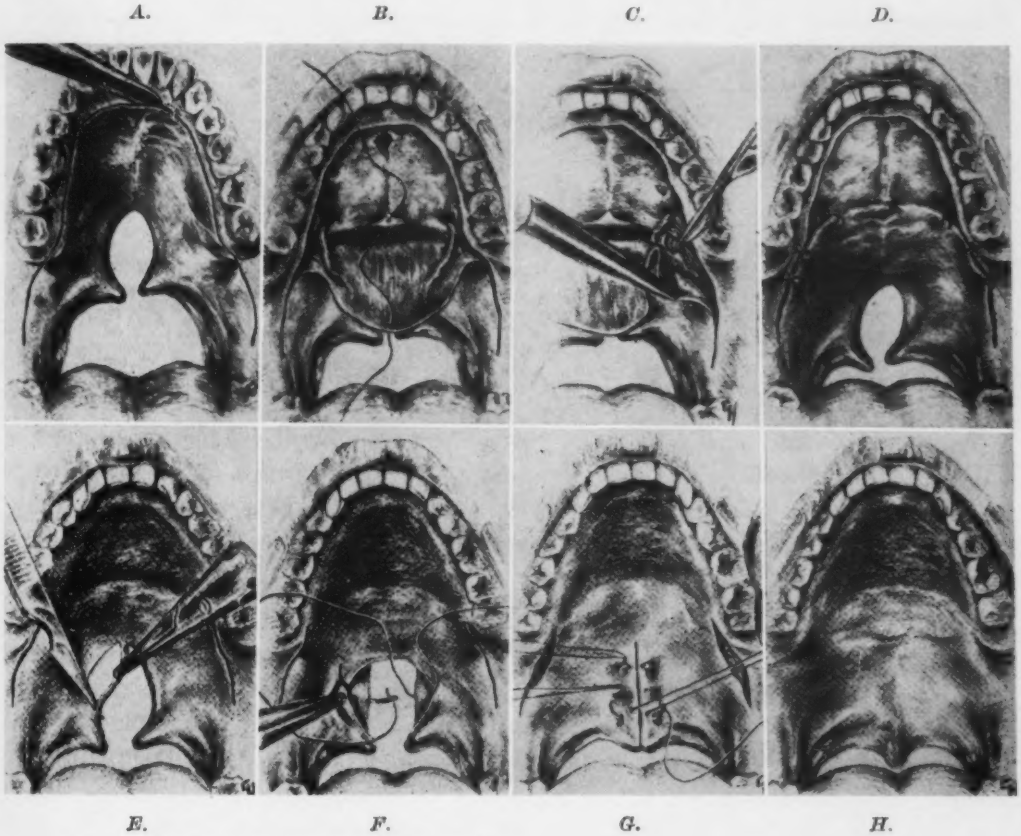


Fig. 5.—Set-back palatal closure operation.

A to *D*, First stage. *A*, Line of incision and beginning elevation of mucoperiosteum. *B*, Diagrammatic representation of palate completely detached from bone, both major palatine arteries intact, and preservation of a band of nasal mucosa to which the palate is attached with the first suture as shown. *C*, Detail diagram of deep separation of the soft tissues, exposure of the hamulus, freeing of the palate aponeurosis in this area behind the artery, and a section of the tensor tendon. *D*, Completion of first stage. The palate has been set back and anchored with horsehair sutures as shown. Several layers of iodoform and balsam of Peru gauze are placed smoothly over the exposed bone and will be retained without sutures for several days.

E to *H*, Second stage. *E*, Beginning of second stage. New openings through the former lateral incisions may or may not be thought necessary. The edge is trimmed off from the tip of the uvula up into the palate substance about 2 mm. *F*, A deep stay suture is usually placed to engage a good bulk of tissue. This may be of catgut and tied on the nasal surface, or it may be of nonabsorbable material and brought out into the mouth. Extra muscle and nasal mucosa sutures may be put in at this stage. *G*, Closure of the cleft with vertical mattress sutures of horsehair. The closure is carried entirely around the uvula and then up onto the nasal surface with fine catgut sutures. *H*, Completed and healed palate set back the distance of the original exposed bone shown in *D*, minus the folding of the soft tissue and the contraction in healing. It is not possible to tell by looking at the palate whether or not it completely closes the nasopharynx, but of course the greater its length, the better is its chance of doing so, provided the levator muscles are functioning. (After Brown, James Barrett: *Surg. Gynec. & Obst.* **63**: 768-771, 1936.)

According to Dorrance,[13] cleft palate patients should be operated upon, when conditions are otherwise favorable, at about the fifth year of life.

The Role of the Pediatrician.—Certainly an interesting approach is that offered by Coursin,[14] who states: "When a baby is born, as soon as the head leaves the perineum, any problem connected with that child is a pediatric, not a surgical one. If the child has a cleft lip, a cleft palate or both, it is the responsibility of the pediatrician to make recommendation as to the time the surgery is expedient. The first operation is determined not by the calendar, but by the condition and nutrition of the baby itself."

The Role of the Otolaryngologist.—Some surgeons contend that failure to close the palatal cleft very early seriously affects not only the nutrition of the child but also the sinus and nasal structures which are continuously subjected to infection due to the wide open passage into the mouth.

If the pediatrician and the surgeon elect to postpone the palatal closure, the otolaryngologist is an important participant in the maintenance of the child's health.

The Role of the Psychologist.—All too seldom are the parents of the cleft palate child given proper attention. Certainly, for the first few years of the child's life they are the psychologist's real patients. Most of the time these parents are left to their own devices. The result is a mixed feeling of pity for themselves and a tendency to overprotect the child and shelter him from the realities of life. Observation of many patients bears this out repeatedly. An attempt to correct this by one unschooled in psychology is sometimes effective but more often, unfortunately, it is not. The appearance of these patients belies their intelligence and capabilities. Another of the psychologist's functions must be instruction of the patients in bringing out these good endowments.

The Role of the Restorative Dentist.—The effect of improper child guidance at home, the dentist's reluctance to treat these patients, and the failure of the medical men to realize the import of tooth preservation leads all too often to a deplorable condition of poor oral hygiene and individual tooth repair. Certainly, the effect of psychology should be clearly felt here, where each dental unit is of inestimable value in securing both an orthodontic and a prosthetic result.

The education of dentists into the intricacies of these problems is also vitally important in the habilitation of patients with cleft lip and cleft palate.

The Role of the Orthodontist.—The orthodontic problem of the cleft palate patient is and should be a challenge to the orthodontist and his ingenuity. Close cooperation between the prosthodontist and the orthodontist is imperative. Never has the term "functional occlusion" been more fitting. In only a small minority of cases is an "anatomic occlusion" possible. Compromise is of ultimate importance in the treatment of cleft palate cases. Eby[15] fittingly described the treatment of such cases when he wrote: "It is my belief that no orthodontic treatment is ever indicated in any type of malocclusion excepting to supply something which nature is missing entirely, or to supplement those

limited efforts on nature's part so as to provide a reasonable equivalent to normal growth. These facts immediately place orthodontics in cleft palate conditions much more in the category of controlling and guiding growth trends rather than merely the correction of malpositioned teeth."

With this in mind, it is only reasonable to believe that when proper stimulation to development is applied early, the difficult orthodontic problem is minimized to some extent. These patients, in many instances, are merely observed and taught to be more tractable in the office. Often the removal of supernumerary teeth or of an impinging frenum is a real contribution to a more normal development. More often than not a growth stimulation to the ever-present maxillary contraction may be effected at as early an age as 3 to 4 years (Fig. 6).

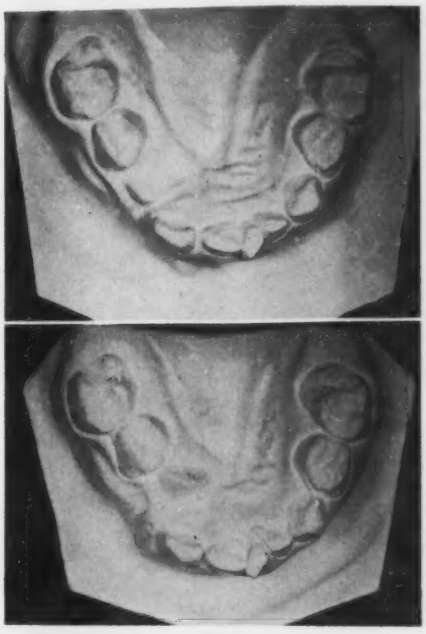


Fig. 6.—Models of a 4-year-old cleft palate patient illustrating the effect of short-term orthodontic treatment (Case 45, Table I). *A*, Before orthodontic treatment. *B*, After ten months of orthodontic treatment.

To enumerate and classify the problems at hand in the orthodontic treatment of a cleft palate case, one may almost pick a patient at random. These major treatment problems are present in almost every case. They may be presented as follows:

1. *Maxillary contraction,* which is usually unilateral in a unilateral cleft and bilateral in a bilateral cleft. There is usually, likewise, a unilateral or bilateral cross-bite. In some cases this condition may be so severe that a complete correction is not always possible.

2. *Pseudomesioclusion,* produced largely by the maxillary deformity. This is a result of the lack of development or arrested development of the maxilla. It is especially difficult to cope with in the

case of bilateral clefts. In order to decrease the size of the mandibular arch for better balance with the maxilla, it often becomes necessary to remove a first premolar on either side of the lower arch. The lower anterior teeth are then moved lingually and distally into the space created. Unfortunately, in many of these cases the lower anterior teeth have a pronounced lingual axial inclination and do not lend themselves to this treatment. Often, in these cases, the removal of a mandibular lateral incisor will provide sufficient space to decrease the mandibular arch size.

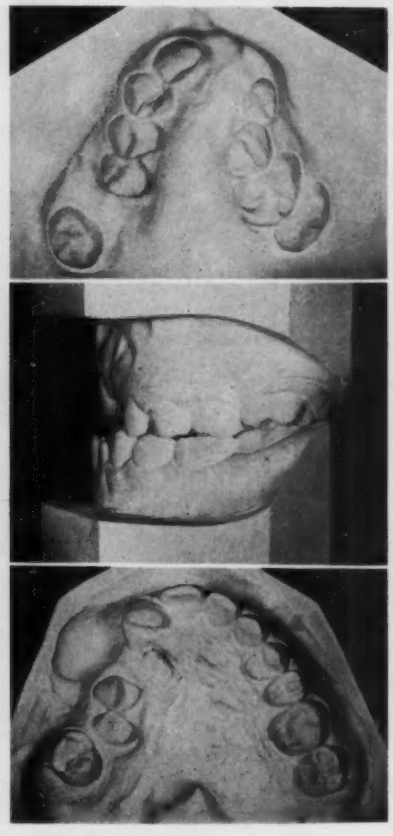


Fig. 7.—Major orthodontic treatment problems in cleft palate patients. *A*, Maxillary contraction (Case 46, Table I). *B*, Pseudomesioclusion (Case 54, Table I). *C*, Malposition of individual teeth (Case 3, Table I).

3. *Malposition of individual teeth,* particularly adjacent to the anterior end of the cleft. In some instances treatment and subsequent prosthetic restoration may be facilitated by the judicious removal of some of these malposed teeth (Fig. 7).

Graber,[16] a pioneer in cephalometric appraisal of persons with cleft palate and cleft lip, has presented the following summary:

1. Cephalometric roentgenographic studies of cleft palate individuals as a group show a deficient pattern of maxillary growth. This deficiency is manifested in three planes of space—laterally, antero posteriorly and vertically.

2. Patients with surgically closed palates are on the extreme end of the range of maxillary deformity. There is a positive correlation between the number of operations and the degree of insult. The same correlation holds true for the amount of scar tissue and resultant withholding of maxillary growth.

3. Patients whose cleft palates have not been surgically manipulated show a pattern of maxillary development that is essentially normal in all respects.

4. Mandibular development in the cleft palate individual shows a slight tendency toward underdevelopment. Excessive intermaxillary clearance allows the mandible to overclose and may be a contributory factor in the frequent complaints of middle ear infections and loss of auditory acuity. Lower incisor inclination is markedly lingual, reflecting increased labial muscular pressure through decussating muscle fibers.

5. To minimize interference with growth centers, it seems advisable to postpone surgical correction of cleft palate at least until the end of the fourth year of life when five-sixths of total maxillary width has been accomplished. However, it must be remembered that downward and forward growth, which depends primarily on the fronto-maxillary, zygomatico-temporal, zygomatico-maxillary and pterygo-palatine sutures, may be active until 20 years of age.

6. Closure of non-operated palatal clefts by prostheses seems quite successful, if the general intelligibility of speech and ease of mastication and deglutition are any guide.

7. Deficient basal bone and restricting scar tissue bands limit correction of tooth positions by orthodontic therapy. It is possible in some instances to actually spread the lateral segments of the maxilla to a better relationship in the middle face, either where scar tissue has been sloughed away or by surgical excision of the scar tissue repair before orthodontic therapy.

Treatment of many cleft palate cases, of necessity, is done in two phases. As soon as it is considered practicable, as mentioned before, the cross-bites are remedied. The maxillary contractions are likewise treated, after which a modified Hawley type of retainer supporting any missing teeth may be inserted. Psychologically and esthetically, the patient is far better off and speech therapy may be instituted early (Fig. 8).

Subsequent to this treatment, after the deciduous teeth are replaced by the permanent dentition, orthodontic therapy may again be necessary before the final efforts of the prosthodontist begin.

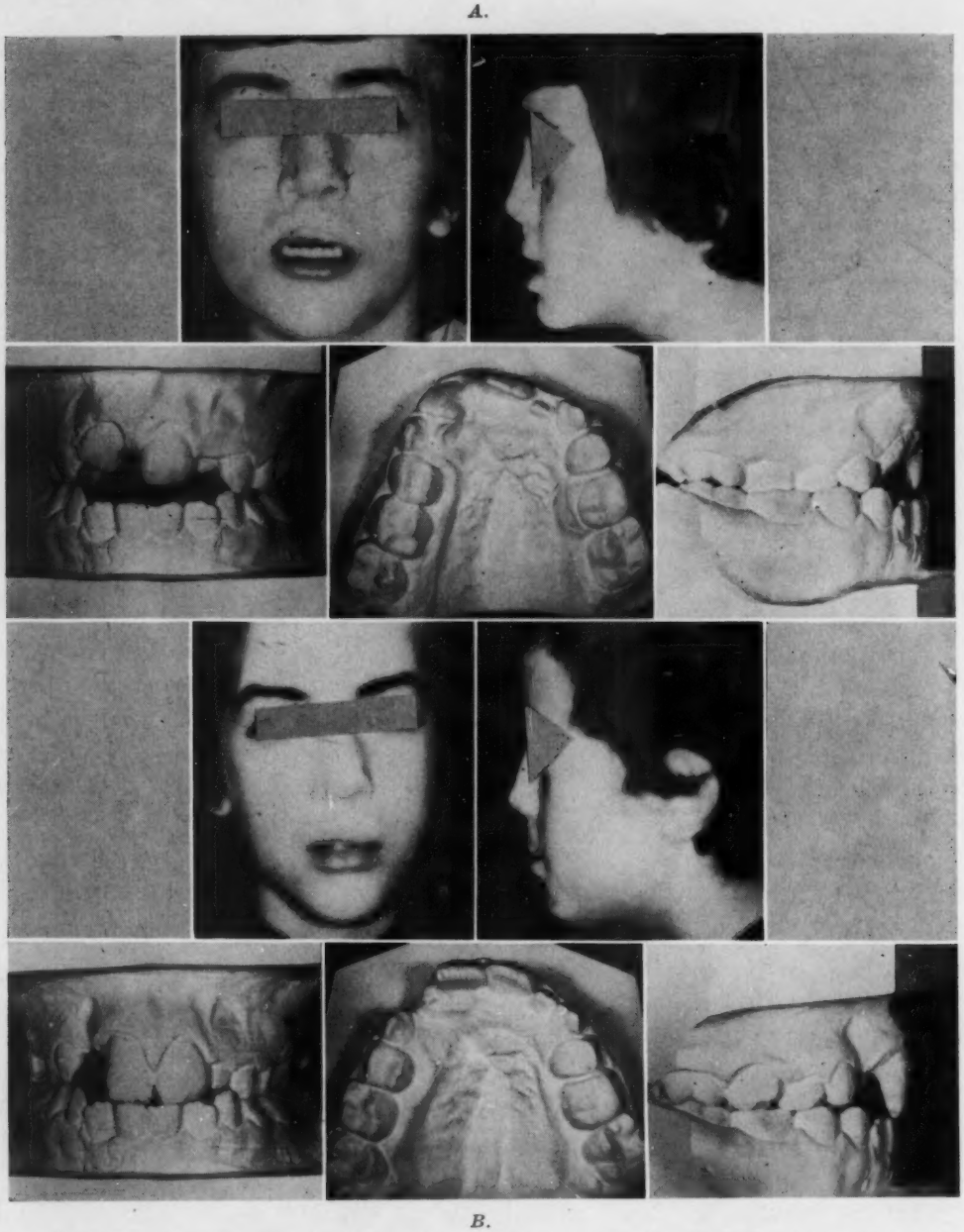
The Role of the Prosthodontist.—Frequent consultations between the orthodontist and the prosthodontist are absolutely essential to better habilitation of the cleft lip and cleft palate patient.

Since in the great majority of cases it is possible to achieve only a functional orthodontic result, it is advisable for the prosthodontist to prepare or to direct the preparation of strategically located teeth for the reception of the prosthesis or dental speech aid.

In the mouths of these patients, caries activity seems relatively high. Since each dental unit is important to the maintenance of a good prosthetic result, a proportionately large number of teeth must be completely jacketed with gold. This is also necessary because, in order to build out maxillary deficiencies, teeth often must be completely encompassed with the acrylic of replacement prostheses.

The efficiency of the prosthetic appliance probably is less concerned with the closure of the more anterior palatal defects than with the furnishing of a

means of closure regulation between the oral pharynx and the nasal pharynx during speech and deglutition.



A.

B.

Fig. 8.—Effect of first phase of orthodontic treatment on a 9-year-old cleft palate patient (Case 54, Table I). *A*, Before treatment. *B*, After treatment.

Higley[17] says: "The prosthodontist needs this understanding (i.e., nasopharyngeal closure) in constructing dental appliances and obturators. Usually swallowing, and not speech, is foremost in the prosthodontist's mind when fitting an obturator. If the prosthodontist understands the physiology of the nasopharyngeal closure during speech he can construct an appliance that will be more satisfactory from the standpoint of speech."

Dorrance[13] states: "Velopharyngeal (nasopharyngeal) closure is accomplished by a sphincter-like mechanism at the lowest part of the nasopharynx, which structure it shuts off from the oropharynx. The structures concerned in causing the closure are the lowermost portions of the nasopharyngeal wall on one side and the velum on the other. The portion of the nasopharyngeal wall which enters into the mechanism is composed of the posterior wall of the nasopharynx, the lateral walls of the pharynx with the eustachian tubes and the salpingopharyngeus muscle. The posterior wall of the nasopharynx where nasopharyngeal closure occurs is formed by the pterygopharyngeal portion of the superior constrictor muscle, which on contraction constitutes what is usually referred to as Passavant's cushion."

Obviously, a great number of cleft palate patients are unable to create a suitable sphincter reaction of the muscles involved to cause the correct nasopharyngeal closure during speech and swallowing. This may be the result of (1) lack of surgical intervention, (2) lack of tissue to provide adequate closure, or (3) excessive scarification and lack of muscular reaction of the tissue in the area after surgery (Fig. 9, *A*, *B*, and *C*).

Provision of a stable, sanitary, and durable replacement for this tissue has long been one of the problems of the prosthodontist.

I would like to acknowledge the cooperation and tireless efforts of Dr. L. Woodrow O'Brien of St. Louis, Missouri, who worked in close harmony with the orthodontic efforts and provided the dental speech aids for all the patients whose records are presented here.

The posterior projection is an acrylic "bulb" joined to the partial denture, the framework of which is a single gold casting. In construction, the partial denture with its posterior cast tailpiece is produced. The bulb is then fashioned from a direct impression, with the patient undergoing the various actions of enunciation and deglutition.

Higley[17] states that while prominent surgeons may describe the action of nasopharyngeal closure clinically, they have no means of recording the nature or extent of movement of the parts involved or their relative positions in the production of various speech sounds. The Iowa roentgenographic studies were made to record some or all of the vertical and anteroposterior movements in nasopharyngeal closure. No satisfactory method was found for recording lateral movements. All these studies employed the Higley head positioner which stabilized the head and oriented it into correct relationship to the film and mid-central ray of the roentgen-ray machine. Only the film needed to be changed; therefore, since the head position was not disturbed, the only changes that were registered in the roentgenogram were those of the organs of speech as they assumed position for the various speech sounds.

Fig. 10 shows samples of tracings made for each of sixty-five subjects studied. The midlines of the structures were traced with radiopaque paste.

These studies prove the necessity for the projected prosthetic "bulb" as a means of replacing nonexistent tissue necessary for the proper functioning of the tongue and other tissues during speech.

The Role of the Speech Correctionist.—Observation of patients who have been trained to a greater or lesser degree by a qualified speech pathologist and teacher has led to the following summary:

1. The desire to find expression in speech is awakened. Most cleft palate patients, being abnormally withdrawn from oral communication, develop different personalities when they learn to speak intelligibly.

2. The quality of speech is greatly enhanced. Lazy speech or pronunciation habits are corrected, as are the "rapid-fire delivery" types of speech. The result is a more intelligible and improved delivery.

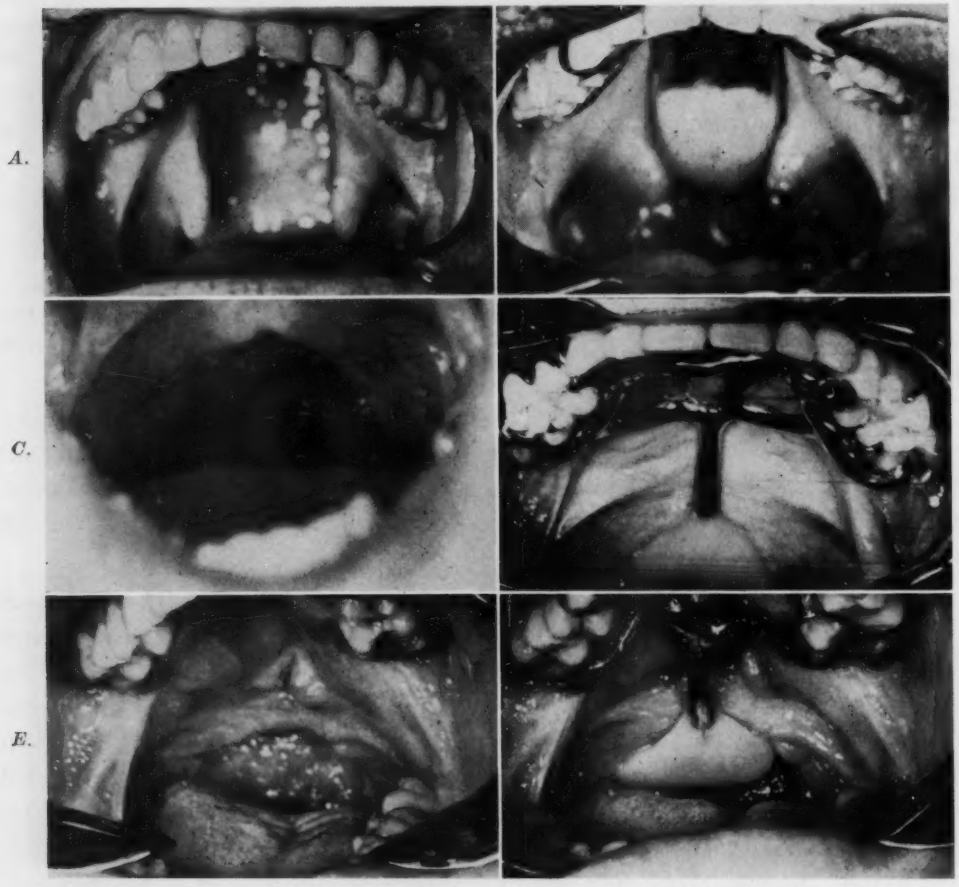


Fig. 9.—Illustration of the types of cases needing assistance from the dental speech aid in producing nasopharyngeal closure. *A*, Lack of surgical intervention (Case 6, Table I). *B*, Case 6 with dental speech aid in position. *C*, Lack of tissue to provide adequate nasopharyngeal closure (Case 4, Table I). *D*, Case 4 with dental speech aid in position. *E*, Excessive scarification and lack of muscular reaction (Case 46, Table I). *F*, Case 46 with dental speech aid in position.

The relationship of dental prosthesis to speech aid is best demonstrated by the following study of speech intelligibility conducted by Madeline C. Haerrter[18] at the Central Institute for the Deaf in St. Louis, Missouri.

Eight persons with cleft palate, all patients of Dr. L. Woodrow O'Brien, were used in the study. The subjects had clefts of the lip which had been repaired, and six of them had had palate repair. The ages ranged from 19 to 59 years. Of the eight subjects, four were men and four were women. Dental speech aids had been worn for a maximum period of 120 days. In educational level, the patients varied from high school graduates to college graduates. Some had had no speech training before the dental speech aid was inserted.

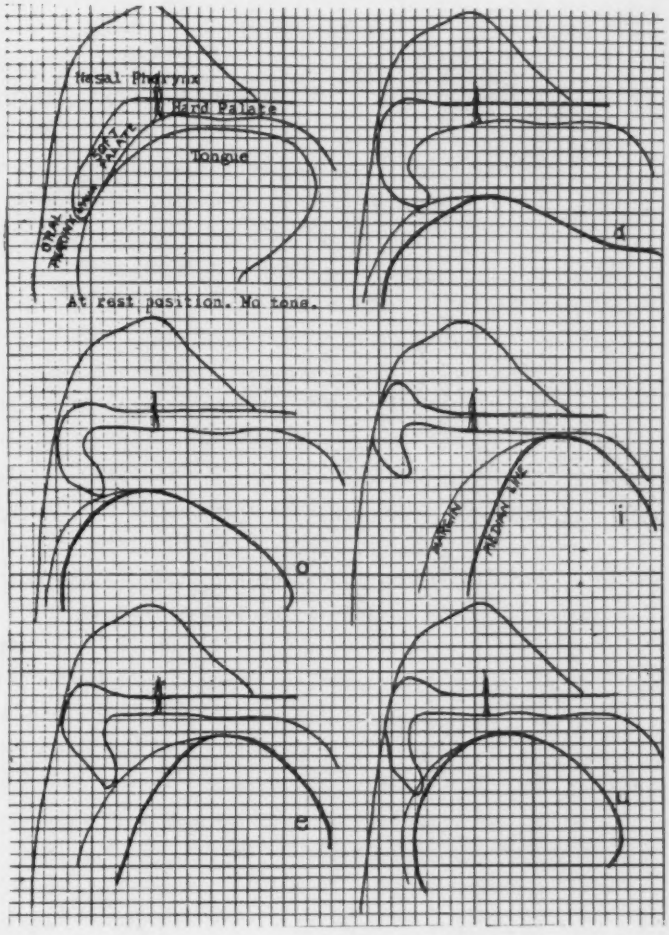


Fig. 10.—Samples of tracings from roentgenographic profiles showing the relation of tongue, soft palate, and uvula during nasopharyngeal closure during phonation of vowels, *A, E, I, O,* and *U.* (After Higley, L. B.: *J. Am. Dent. A.* **30**: 1716-1725, 1943.)

Among those who had taken speech lessons, the amount of time spent on such lessons varied from little or no practice outside the clinical lessons to hours of practice at home every day.

Before a dental speech aid was constructed for the subjects, the patient's reading of a prescribed list of words was recorded. After insertion of a dental speech aid the same words were recorded, with care being exercised to scramble the sequence of the words.

TABLE II

CASE NO.	SEX	AGE	LOCATION OF CLEFT*						SURGICAL REPAIR	ORTHODONTIC TREATMENT	SPEECH LESSONS (HOURS)	TIME WEARING SPEECH AID (DAYS)	SPEECH INTELLIGIBILITY	
			LIP			PALATE							WITHOUT SPEECH AID (PER CENT)	WITH SPEECH AID (PER CENT)
			L	R	B	L	R	B						
1	M	25	x			x			Yes	Yes	14	30	74	84
2	M	22			x			x	Yes	Yes	4	2	75.34	79.83
3	M	34	x			x			Yes	No	25	2	82.03	89.17
4	M	19	x			x			Lip, yes; palate, no	No	None	30	88.33	92.73
5	F	47	x			x			Yes	No	5	120	85.53	98.73
6	F	59	x			x			Lip, yes; palate, no	No	None	60	78.10	84.60
7	F	36	x			x			Yes	No	7	60	62.73	69.47
8	F	36	x			x			Yes	No	7	90	92.13	96.77

*L = Left.
R = Right.
B = Bilateral.

Thirty listeners were used. They were subjected first to a normal pronunciation of the list of words. They then listened in turn to the recordings of the patients with and without the dental speech aids, writing the words as they heard them pronounced. It is interesting to note that no listener obtained a score of 100 per cent on the pronunciation of the words of a normal speaker.

The result of this speech intelligibility test is shown in Table II. Statistics gathered from the table are as follows:

Female subjects tested, 4 (50 per cent).
Male subjects tested, 4 (50 per cent).
Oldest patient, 59 years.
Youngest patient, 19 years.
Number of cleft lips, 8 (100 per cent).
Number of left unilateral cleft lips, 7 (87.5 per cent).
Number of right unilateral cleft lips, none.
Number of bilateral cleft lips, 1 (12.5 per cent).
Number of cleft palates, 8 (100 per cent).
Number of left unilateral cleft palates, 7 (87.5 per cent).
Number of right unilateral cleft palates, none.
Number of bilateral cleft palates, 1 (12.5 per cent).
Number of cleft lips not surgically repaired, none.
Number of cleft palates not surgically repaired, 2 (25 per cent).
Number of patients who were edentulous, 1 (12.5 per cent).
Number of patients who had received orthodontic treatment, 2 (25 per cent).
Number of patients who had had speech training, 6 (75 per cent).
Number of patients who had not had speech training, 2 (25 per cent).
Highest number of hours of speech training, 25.
Average number of hours speech training, 7.7.
Longest time wearing speech aid, 120 days.
Shortest time wearing speech aid, 2 days.
Average time wearing speech aid, 49.2 days.
Highest percentage of increased speech intelligibility with speech aid, 13.2 per cent.
Lowest percentage of increased speech intelligibility, 4.4 per cent.
Average percentage of increased speech intelligibility, 7.13 per cent.

Conclusive proof of the value of speech direction has been furnished me not only by the foregoing tests but by attendance at numerous clinics and seminars held at Central Institute for the Deaf and Washington University School of Dentistry. The patients used in the foregoing tests, as well as others, have been audited and observed.

Results of Integrated Services.—Cooperative, concerted effort toward the habilitation of the cleft palate patient has been unquestionably established as the only means for achieving maximum success.

Fig. 11.

Fig. 12.

Fig. 11.—A case of left unilateral cleft palate before habilitation (Case 46, Table I).
Fig. 12.—Case 46 after habilitation, with and without the dental speech aid.

Figs. 11, 12, 13, and 14 illustrate the clinical results that can be achieved by strict adherence to the aforementioned principles.

SUMMARY

1. Preparation of congenital cleft palate patients for normal life is a challenge to the efforts of modern medical science.

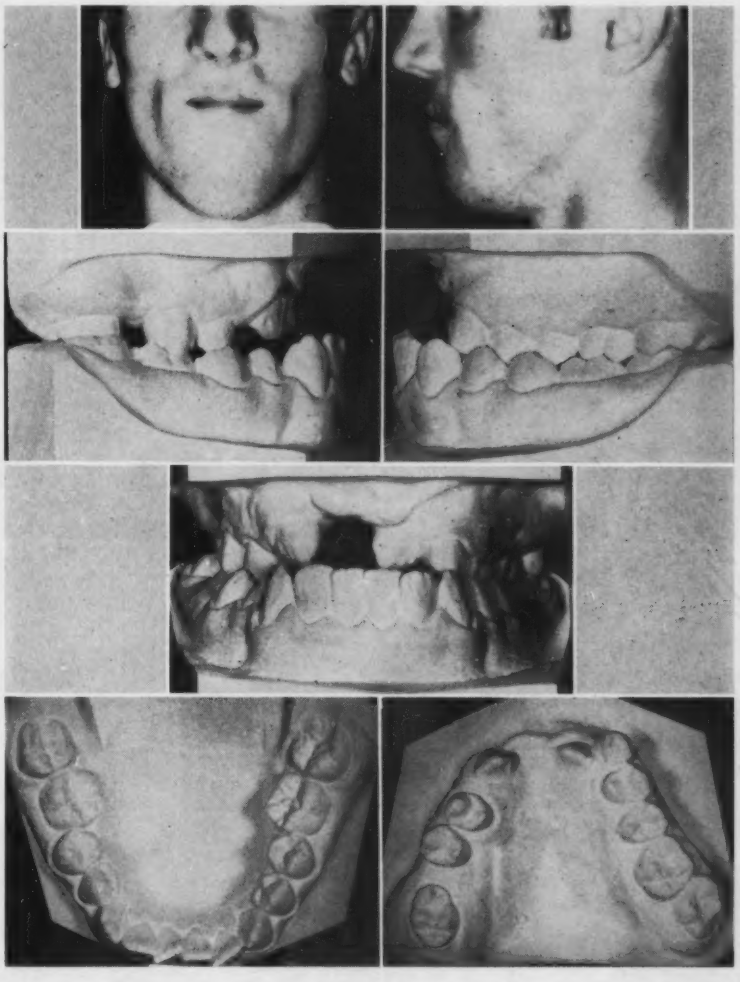


Fig. 11.—A case of left unilateral cleft palate before habilitation (Case 46, Table I).
Fig. 12.—Case 46 after habilitation, with and without the dental speech aid.

Fig. 13.—A case of bilateral cleft palate before habilitation (Case 71, Table I).

2. The causative factors leading to cleft lips and palates are recognized as defects in intrauterine development of the embryo during the second month of fetal life.

3. The etiological factors as to *how* clefts occur are far better understood than the reasons *why* they occur. One school of thought holds that a gene defect is responsible, thereby indicating inheritance. Valuable experimentation has proved that clefts may be produced by environmental situations, such as lack of oxygen or subjection of the mother to such drugs as cortisone.

4. The occurrence of clefts is recognized as approximately one in 700 live births. In extremely large samples of population it has been found that 70.83 per cent of all clefts occur in males and 29.17 per cent in females. I have found that far more than twice as many clefts occur on the left side as on the right. It has been authoritatively stated that 16 per cent of all cases presented bilateral clefts. In my sampling, 47.3 per cent were bilateral in the palate and 30.5 per cent were bilateral in the lip.

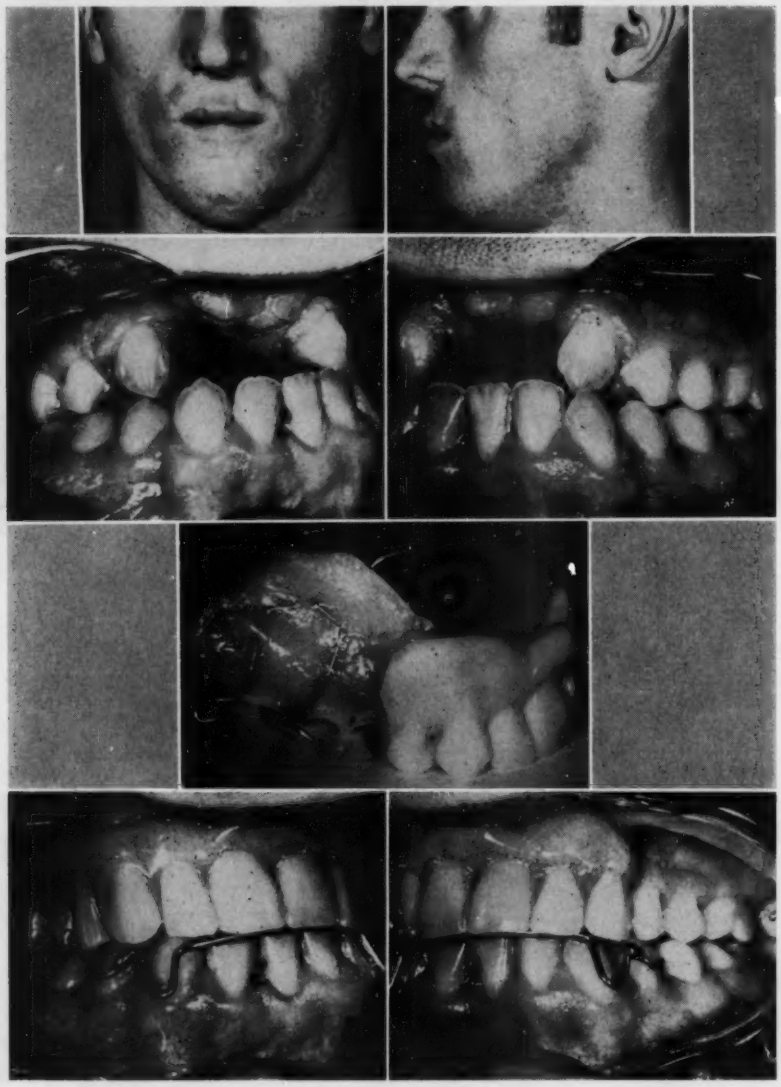


Fig. 14.—Case 71 after habilitation, with and without dental replacement. Nasopharyngeal closure in this case did not require posterior "bulb."

5. The total habilitation of the patient with cleft lip and cleft palate has been found to be best achieved through the combined efforts of pediatrician, surgeon, psychologist, otolaryngologist, restorative dentist, orthodontist, prosthetic dentist, and speech pathologist.

6. In addition to obvious cosmetic improvement, the speech intelligibility of a patient benefiting from integrated habilitation was found to increase as much as 13.2 per cent, with an average increase for the sample of 7.13 per cent.

CONCLUSIONS

It is believed that the habilitation of the patient with cleft lip and cleft palate reaches the optimum when that patient has been the recipient of the combined skills of several professions working together. By this method, and only by this method, the patient can be stimulated to reach a more normal level of health, function, and esthetics.

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225 S. MERAMEC.

Editorial

WHAT IS NEW IN ORTHODONTICS AT DENVER

ORTHODONTICS begins long before you fashion a band or bend an arch wire. It is a biotechnological specialty which goes far afield and borrows from many scientific disciplines. The program of the Denver meeting reaches out into these fields. Outstanding authorities will inform you of advances in the related arts and sciences which enter into the successful orthodontic practice. The Denver program goes directly to the sources.

What is new? You can find out for yourself what is new in orthodontics, your specialty, by attending the 1961 meeting of the American Association of Orthodontists to be held in Denver, Colorado, April 16 to 20. Why wait to hear about it later, when it is no longer news and when your patients and you have missed the advantages of early, first-hand information?

The preliminary program of the Denver meeting was published in the January, 1961, issue of the JOURNAL. But this does not tell the whole story. It does not tell you that a small group of orthodontists have been planning and working for almost two years to prepare the scientific program and the social events which you are now being invited to attend.

The Tuesday session will provide the answer to the question that orthodontists so frequently ask themselves: "So what—where does it apply in my practice?" How often have you listened to papers on subjects which somehow, somewhere, have a bearing on your daily practice, but without clearly understanding where this bearing belongs and how it applies in your practice? The Denver program does not let matters rest at this point. On Tuesday the essayists who have presented source material on Monday will sit as a panel. They will answer questions propounded by well-known orthodontic teachers and practitioners, each of whom is an authority in his own right.

Round-table discussions, general clinics, and registered clinics have been prepared with special care. Clinics will be presented also on closed-circuit television.

What are you actually doing for and to your patients during treatment? Do your thinking and your practice depend on the "system," or are they dictated by the actual needs of your individual patient? Answers will be presented at the two-hour session on Thursday morning. The Thursday morning scientific session is something new in orthodontic meetings. Read the preliminary program again for the names of the participants.

Decisive changes are facing orthodontics as a specialty. The Council on Dental Education of the American Dental Association is in the process of

instituting certain rules on specialty practice and the certification of specialists. The December issue of the JOURNAL (pages 910 to 924, inclusive) contains information on these impending changes. This information should be read and studied by every practicing orthodontist. At the Denver meeting you will hear a report on, and can lend your support to, the important decisions that will be adopted. Many other important matters affecting your Association, your specialty, and you as a specialist will be discussed and acted upon. Your voice and your vote should not be denied, even as you would not want them to be denied.

The Rocky Mountain Society of Orthodontists has really gone all the way in making certain that the social aspects of the meeting will meet and surpass all tests of true Western hospitality. The Denver meeting is not just another meeting. It is the high point of the year in the specialty to which you devote your professional life. If you have not already done so, take the necessary steps now to attend this meeting. By making early reservations for all events you will avoid disappointment later.

J. A. Salzmann, Chairman
A.A.O. Program Committee

Department of Orthodontic Abstracts and Reviews

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DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City.

Abstracts of Papers Presented Before the Research Section of the American Association of Orthodontists, Washington, D. C., April 26, 1960

A Longitudinal Study of Untreated Class II Type Malocclusions: By Franz J. Frölich, Dr. med. dent., Forsyth Dental Infirmary, Boston, Massachusetts.

The material consists of serial plaster casts of fifty-one children observed during the transitional period. The malocclusions were divided, on the basis of the last model in each series, into the following categories: Class II, Division 2, Class II borderline between Division 2 and Division 1, Class II, Division 1 V-shaped, and Class II, Division 1 flaring and spacing. Dental arch length, intercanine, and Intermolar distance were measured and the standard scores computed from normative data (Moorrees). Fisher's "t" test was performed to determine if there was a significant difference between the four categories with regard to the features measured.

It was found that 90.5 per cent of all measurements fall within the 2 standard deviation limit of the norm. Maxillary arch length tends to be shorter in the Class II Division 2 group and larger in the Class II Division 1 flaring and spacing group as compared with the norm. There is a significant difference between the Division 2 and the Division 1 categories in regard to arch length. Maxillary arch breadth tends to be narrower than the norm in the V-shaped and flaring and spacing groups, whereas it tends to be broader than the norm in the Class II Division 2 and borderline groups. In intercanine distance, the Class II, Division 2 and the borderline groups differ significantly from the Class II, Division 1 V-shaped and flaring and spacing groups. In intermolar distance, there is a significant difference only between the Class II, Division 2 and the Class II, Division 1 flaring and spacing groups. Mandibular arch shape appears very similar in the four categories of Class II type malocclusions.

An Investigation of the Extent of the Need for Orthodontic Services: By Harold L. Brehm, D.D.S., and Delbert L. Jackson, Jr., D.M.D., Tufts Cleft Palate Institute, Boston, Massachusetts.

A survey was made in the public school systems of three eastern Massachusetts communities to determine the extent of the orthodontic problem. It was hoped that the size and choice of the sample could be used as a guide in the development of a public health approach to the problem.

The cities chosen for the survey were Newton, Massachusetts; Sudbury, Massachusetts; and Walpole, Massachusetts.

A form was developed, and the individual items were defined. Notations were made according to predefined degrees of severity. The survey was made

by members of the faculty of the orthodontic department at Tufts under a grant received through the Cleft Palate Institute.

The pupils of the first, second, third, sixth, and twelfth grades of the aforementioned school systems were included in the survey.

In all, 6,328 children were examined. The results of the examination were tabulated and evaluated. The amount and type of data permit a considerable number of approaches in its evaluation.

Several statistical approaches were employed. One involved dividing the examined mouths into groups according to Angle's classification. This resulted in the following percentages:

Normal	16.6
Malocclusion	83.4
Class I	60.1
Class II	22.8
Class III	0.5

When analyzed according to degrees of severity, the data indicated that 33 per cent of those examined had malocclusions in the most severe category.

14 Parker St.
Lexington, Mass.

A Roentgenographic Appraisal of Growth and Function of the Oro-Facial Structures of Operated Cleft Palate Children: By Wing You Tong, D.D.S., M.S.D., University of Nebraska, Lincoln, Nebraska.

The purposes of this study were (1) to compare the facioskeletal growth and development of cleft patients operated upon by the Brophy-Shearer method with known standards and (2) to determine whether or not, in these operated cleft palate cases, nasality can be correlated to velopharyngeal function as seen in the lateral head roentgenogram. Seventy-nine subjects (forty-one females and thirty-eight males) were used in this study. Their ages ranged from 4 years to 18 years. A total of thirty-two angular and linear measurements were taken from two lateral cephalometric head films of each subject. These measurements were statistically compared to standards as compiled by Downs, Reidel, and Coben.

The present evaluation led to the following conclusions:

1. The middle face of the unilateral and bilateral cleft lip and palate subjects, aged 9 years 7 months to 18 years, exhibited deficient length.
2. The absolute ramal height of the mandible was significantly shorter than normal.
3. The gonial angle was definitely more obtuse than normal.
4. Generally, the cleft groups aged 4 years 5 months to 9 years 6 months showed a tendency to be statistically similar to the normal group in the proportional craniofacial measurements. However, the cleft groups above 9 years 6 months of age showed statistically significant differences in craniofacial proportions. The significant tendencies were deficiencies of growth in the maxillary length and ramal height of the mandible.
5. When the statistical correlation was made between hypernasality and the amount of velopharyngeal closure during the phonation of the "u" sound, these measurements showed a highly significant positive correlation. Therefore, it is felt that the measure of the

amount of closure of the velopharyngeal port during the production of the "u" sound can be used as a diagnostic aid in the determination hypernasality in speech. However, this procedure should be used with the full understanding of limitations of this type of analysis.

6. The success of the surgical soft palate cleft repair as measured by the individual's functional speech quality (that is, speech that is generally acceptable, intelligible, with only slight hypernasality) was only 31 per cent.

1521 South King St.
Honolulu, Hawaii.

Cephalometric Roentgenographic Patterns Associated With Malocclusion: Sex and Age Differences: By Irwin Steurer, D.D.S., Lawrence Hermann, D.D.S., and Robert H. Thompson, Jr., Columbia University, New York, New York.

In order to investigate sex and age differences within malocclusion groups, diagnostic records of 1,500 Caucasian children were surveyed and 200 cases were selected for analysis on the basis of clearly defined malocclusion and excellence of the cephalometric roentgenogram. Of eighty Class I malocclusions studied, there were twenty male mixed dentition, twenty male permanent dentition, twenty female mixed dentition, and twenty female permanent dentition. Eighty Class II, Division 1 cases were similarly selected. As available mixed dentition material was limited, only forty permanent dentition Class II, Division 2 cases, equally divided as to sex, were studied. The values obtained from the Downs analysis and angles SNA and SNB were subjected to statistical analysis.

In addition, ten cephalometric roentgenograms, selected at random, were analyzed independently by each investigator to test for observer variability. Greatest disagreement in mean values was discovered in those measurements utilizing the occlusal plane, which places in doubt the reliability of this particular plane.

No significant differences were found within the Class I and Class II, Division 2 malocclusion groups. Significant sex and age differences were found, however, when the subgroups within the Class II, Division I malocclusion group were compared. In the permanent dentition, boys exhibited a more pronounced Class II skeletal pattern than girls. In a comparison of Class II, Division 1 mixed and permanent dentition subgroups in each sex, statistically significant differences indicate a more severe Class II skeletal pattern in the older group for both boys and girls. The results of this investigation indicate that no improvement in the Class II skeletal pattern can be expected with the passage of time.

654 Madison Ave.
New York, N. Y. (Dr. Steuer).

Observations of Pressure Phenomena on Bone In Vivo: By Charles R. Cushing, D.M.D., Harvard School of Dental Medicine and Children's Medical Center, Boston, Massachusetts.

According to the method previously described (Cushing, C. R.: Quantitative Approach to the Study of Pressure Phenomena in Living Bone, Am. J. Orthodontics 45: 871, 1959), the bodies of the scapulae in laboratory rats were subjected to continuous pressures by means of small pairs of magnets encased in acrylic. The pressures studied ranged from less than 11.5 Gm./cm.^{2} to 68 Gm./cm.^{2}, and the experimental time was one, two, and three weeks. Apart

from the operative trauma and a minimal foreign body tissue reaction, at all pressures studied bone necrosis and a characteristic repair reaction occurred in the intervening bony plate. A significant proliferative bony reaction occurred in the control, nonpressurized areas and adjacent to but not between those magnets in good alignment. These influences of pressure on the formation and resorption of bone have to be considered in the light of the microscopic characteristics of the tissues and also of the mechanics involved in the application of the pressure.

Finally, although some of the pressures greatly exceeded capillary blood pressure (approximately 30 Gm./cm.^{2} maximum), complete necrosis did not occur in the tissues so compressed, and the pressures used did not prevent bone resorption and bone deposition or fibrous tissue and capillary proliferation.

300 Longwood Ave.
Boston, Mass.

Transformation of the Temporomandibular Joint During Orthodontic Treatment: By Prof. Dr. med., Dr. med. h.c. Karl Häupl, Westdeutschen Kieferklinik, Düsseldorf, Germany.

The report concerns the problem of whether the possibility exists that the mandible changes its position during orthodontic treatment.

Three cases are described to prove the postural change of the mandible.

In the first case a newborn child showing the typical Pierre Robin syndrome, particularly severe distal displacement of the mandible, needed orthopedic treatment because the condition severely interfered with breathing. The orthopedic therapy consisted of a forward pull of the mandible with the help of a wire which was fixed. The very frail child died some days after treatment was finished, and both temporomandibular joints were histologically investigated. The sections showed that a transformation in the tissues of the head and of the ridge in both joints had taken place. These tissue changes caused by the treatment gave rise to change of the position of the mandible in an anterior direction. These are the first histologic findings in a human being.

The other two cases represent Angle Class II, Division 2 and Angle Class III malocclusions. Cephalometric roentgenograms were taken in both cases at the beginning and at the end of the treatment. Both roentgenograms presented the same position, superimposing again all check in both cases. It could be seen that the mandible was moved in a mesial direction in Case 2 and in a distal direction in Case 3.

News and Notes

American Association of Orthodontists 1961 Annual Meeting

Preparations are continuing for this year's meeting of the American Association of Orthodontists which will be held April 16 to 21, 1961, at the Denver Hilton Hotel in Denver, Colorado. A detailed program appeared in the January issue of the JOURNAL, but we take this opportunity to remind A. A. O. members that the following scientific papers will be presented:

PRINCIPLES OF CRANIOFACIAL DEVELOPMENT ASSESSED BY EXPERIMENTAL BIOLOGY (the John Valentine Mershon Memorial Lecture). Louis J. Baume, D.M.D., M.S., Geneva, Switzerland.

RECENT DEVELOPMENTS IN BIOLOGICAL STUDIES ON THE OSSEOUS SYSTEM. C. Willet Asling, M.D., Ph.D., Berkeley, California.

RESEARCH AND MALOCCLUSION. Stanley M. Garn, Yellow Springs, Ohio.

USES AND LIMITATIONS OF ELECTROMYOGRAPHY IN THE QUANTITATIVE STUDY OF SKELETAL MUSCLE FUNCTION. Henry J. Ralston, Ph.D., San Francisco, California.

SYSTEMIC DISTURBANCES IN RELATION TO GENERAL AND DENTOFACIAL GROWTH AND DEVELOPMENT IN CHILDREN. John F. Crigler, Jr., M.D., Melvin I. Cohen, D.M.D., and M. H. Wittenborg, M.D., Boston, Massachusetts.

SECOND AND THIRD MOLARS: THEIR ROLE IN ORTHODONTIC THERAPY (A. B. O. thesis). Malcolm R. Chipman, Spokane, Washington.

In addition, there will be a panel discussion of the above essays, a round-table discussion of "Systems Versus Basic Principles in Orthodontics," and general and registered-attendance clinics.

Other traditional features of the meeting will include the annual Golden Anniversary Luncheon, presentation of the Albert H. Ketcham Memorial Award, a round-table luncheon, presentation of the Milo Hellman Research Award, and a number of pleasant social events.

Information for A. A. O. Skiers

The membership of the American Association of Orthodontists has shown considerable interest in skiing previous to and following the annual meeting in Denver. Skiers interested in obtaining reservations are urged to write to one of the following for information:

Robert C. Blenkner, 2465 South Downing, Denver, Colorado
Daryl R. Burns, 158 Fillmore St., Denver, Colorado
Robert S. Freeman, 3705 E. Colfax Ave., Denver, Colorado
Charles W. Hasstedt, 3705 E. Colfax Ave., Denver, Colorado
William C. Jackson, 1232 Republic Bldg., Denver, Colorado

Albert L. Miller, 1690 Milwaukee St., Denver, Colorado
Howard L. Wilson, 1107 Republic Bldg., Denver, Colorado
Fred J. Wuthrich, 158 Fillmore, Denver, Colorado

It would probably be better to come for skiing before the meeting rather than after, as the snow will probably be better then.

American Association of Orthodontists
Registration of Guests at Annual Meeting

To ensure full participation of all active members of the American Association of Orthodontists, the following classification of nonmembers eligible to attend and schedule of attendance fees, which will be charged at the time of registration, have been established for annual session of the Association at the Denver Hilton Hotel in Denver, Colorado, April 16 to 21, 1951.

A. *No Attendance Fee.*

1. Full-time teachers in university dental schools.
2. Full-time graduate or postgraduate students in university orthodontic departments. It will be necessary to present a letter from the dean of the school certifying the status of the student.
3. Dentists from outside Canada or the United States of America who are members of recognized dental or orthodontic organizations.
4. Regular and associate members of the A. A. O.
5. All wives in attendance.

B. *Attendance Fee—$10.00.*

1. Graduates (within the past three years) of university orthodontic departments who are in Government service.

C. *Attendance Fee—$50.00.*

1. Graduates of University orthodontic departments who are not members of constituent societies of the American Association of Orthodontists.
2. Other guests.

Applications for guest privileges should be in the hands of the Credentials Committee sixty days prior to the annual meeting, and preregistration of such guests shall be compulsory.

As published in the JOURNAL, those persons who would be classified under the heading of C-1 or C-2 above are required to apply to the chairman of the Credentials Committee at least sixty days before the session for proper forms, which required (a) written endorsement by two active members of the A. A. O. in the applicant's vicinity, (b) that the applicant be a member in good standing of the American Dental Association, and (c) that the applicant never has been rejected for membership in any of the constituent societies of the A. A. O.

Those persons who would be classified under the headings of A or B are required only to submit credentials identifying themselves as being in one of these categories at the time of registration. Registration under categories C-1 and C-2 will be limited in keeping with available facilities and accommodations.

Note: Associate members of the A. A. O. now come within a separate category covering membership in constituent societies and are no longer regarded as guests. Therefore, no fee will be required for persons in this category.

George E. Ewan, Credentials Chairman

1961 Prize Essay Contest, American Association of Orthodontists

Eligibility.—Any member of the American Association of Orthodontists and any person affiliated with a recognized institution in the field of dentistry or associated with it as a teacher, researcher, undergraduate, or graduate student shall be eligible to enter the competition.

Character of Essay.—Each essay submitted must represent an original investigation and contain some new significant material of value to the art and science of orthodontics, and it must be the contestant's first research orthodontic publication.

Prize.—A cash prize of $500.00 is offered for the essay judged to be the winner. The committee, however, reserves the right to omit the award if, in its judgment, none of the entries is considered to be worthy. Honorable mention will be awarded to those authors taking second and third places. The first three papers will become the property of the American Association of Orthodontists and will be published. All other essays will be returned.

Specifications.—All essays must be in English, typewritten on 8½ by 11 inch white paper, double spaced, with at least 1 inch margins. Each sheet must be numbered and bound or assembled with paper fasteners in a "brief cover" for easy handling. The title of the essay should appear on the cover. Three complete copies of each essay, including all illustrations, tables, and bibliography, must be submitted. The name and address of the author must not appear in the essay. For purposes of identification, the title of the essay and the author's name, together with a brief biographical sketch which sets forth his or her dental and/or orthodontic training, present activity, and status (practitioner, teacher, student, research worker, etc.), should be typed on a separate sheet of paper and enclosed in a plain sealed envelope. The envelope should include the title of the essay.

Presentation.—The author of the winning essay will be invited to present it at the meeting of the American Association of Orthodontists to be held in Denver, Colorado, April 16 through 21, 1961.

Judges.—The entries will be judged by the Research Committee of the American Association of Orthodontists.

Final Submission Date.—No essay will be considered for this competition unless it is postmarked on or before Feb. 27, 1961, and received in triplicate by Dr. Albert P. Westfall, University of Texas, Department of Orthodontics, Houston, Texas.

Herbert I. Margolis, Chairman, Research Committee
American Association of Orthodontists;
Professor of Orthodontics
Boston University School of Medicine
Department of Stomatology
80 East Concord St.
Boston, Massachusetts.

American Association of Orthodontists 1961 Research Meeting

Continuing the policy of recent years, the program will consist of a series of ten-minute research reports which may be presented orally or read by title only. All persons engaged in research are urged to participate in this program, which will be held April 16 through 21, 1961, in Denver, Colorado.

Each participant is asked to prepare a 250-word abstract for publication in the AMERICAN JOURNAL OF ORTHODONTICS. Abstracts for publication and the ten-minute oral

presentation at the meeting should be carefully prepared to present an adequate description of the import of the investigation.

Forms for use in submitting the titles and 250-word abstracts of research projects will be sent to each dental school orthodontic department and to any individual requesting one. Please send your title and abstract as early as possible, but not later than March 1, 1961, to Dr. Richard A. Riedel, Medical-Dental Building, Seattle, Washington.

Herbert I. Margolis, Chairman, Research Committee
American Association of Orthodontists;
Professor of Orthodontics
Boston University School of Medicine
Department of Stomatology
80 East Concord St.
Boston, Massachusetts

American Board of Orthodontics

The next meeting of the American Board of Orthodontics will be held at the Denver Hilton Hotel in Denver, Colorado, April 10 to 15, 1961. Orthodontists who desire to be certified by the Board may obtain application blanks from the secretary, Dr. Alton W. Moore, University of Washington School of Dentistry, Seattle 5, Washington.

Applications for acceptance at the Denver meeting, leading to stipulation of examination requirements for the following year, must be filed before March 1, 1961. To be eligible, an applicant must have been an *active* member of the American Association of Orthodontists for at least two years.

Northeastern Society of Orthodontists

The next meeting of the Northeastern Society of Orthodontists will be held at the Commodore Hotel in New York City on March 6 and 7, 1961. The tentative program follows.

Sunday, March 5

Registration.
Cocktail Party.

Monday, March 6

A Presentation of an Orthodontic Case—From Inception to Completion—With Audiovisual Aids. Thomas M. Graber, Chicago, Illinois.

Incidence and Treatment of First Permanent Molar Extraction Cases. Samuel G. Gilbert, Philadelphia, Pennsylvania.

Clinical Examination and Functional Diagnosis. Robert M. Ricketts, Pacific Palisades, California.

Contemporary Cephalometric Analysis. Robert M. Ricketts, Pacific Palisades, California.

Tuesday, March 7

The Influence of Orthodontic Treatment on Growth and Development. Robert M. Ricketts, Pacific Palisades, California.

Treatment Planning on the Basis of the Individual Potential and Possibilities. Robert M. Ricketts, Pacific Palisades, California.

Light Differential Forces in Clinical Orthodontics. Joseph R. Jarabak, Hammond, Indiana.

Table Clinics.

Clinical Documentation Supplementing Essay by Dr. Jarabak. (The versatility of the differential appliances will be shown with the presentation of ten cases treated with this technique. Intraoral Kodachromes, cephalometric x-rays, and casts will be used in this documentation to supplement morning paper.)

American Dental Association

SHAILER PETERSON TELLS OF DENTISTRY'S EVOLUTION

"Dentistry is in the early stages of an evolution" which will bring about changes in methods of providing dental care as well as allocation of duties for rendering this care, according to Dr. Shailer Peterson, Chicago, assistant secretary for educational affairs of the American Dental Association.

Although the ratio of dentists to population will be less favorable in 1975 than it is today, Dr. Peterson asserted that dentistry fully expects to be able to keep pace with increased demands for dental care of an exploding population.

Addressing a symposium held on Dec. 29, 1960, at the Biltmore Hotel in New York City in conjunction with the 127th meeting of the American Association for the Advancement of Science, the ADA official said that there is likely to be one dentist for every 2,450 persons by 1975—excluding teachers and practitioners employed by the federal dental services. This would compare with the present ratio of one dentist for every 2,150 persons.

This means that by 1975 the country will be short by about 5,000 dentists in matching the present ratio and by about 40,000 in recalling the 1930 ratio of one dentist to 1,728 persons.

Studies of dentistry's needs for the future seemingly have the entire profession "manpower conscious," according to Dr. Peterson. He said that never before in the history of American dentistry have so many of the agencies associated with the profession shown such an acute awareness of a situation and expressed so much willingness to act together in solving it.

The dental educator cited as part of the emerging "dental evolution" several changes designed to prevent a lack of dental service in the future:

The average dentist has shown in the past ten years that he can increase his productivity of service by 29 per cent.

Many regions in the United States are attempting to eliminate shortages of dentists by correcting inequitable distribution of practitioners. (This type of program Dr. Peterson described as perhaps being even more important than recruiting more dental students and encouraging the expansion of present dental schools and the creation of new ones. He said that figures showing the ratio of dentists to population on a national basis often are misleading, because the availability of dental service varies greatly from state to state. A large part of the problem of providing dental service thus centers around distribution of dentists.)

Auxiliary personnel are being called upon to render a larger proportion of the dental service, always under direct supervision of the dentist. (Dr. Peterson pointed out that the Association is on record as encouraging dental schools to institute research programs aimed at studying the functions of the dental assistant and the dental hygienist. Ultimate purpose of the programs, he explained, is to help the dental team operate more efficiently.)

SEVENTEENTH CONGRESS ON DENTAL EDUCATION AND LICENSURE

The program for the American Dental Association's Seventeenth Congress on Dental Education and Licensure will center around panel discussions of four major recommendations of the Commission on the Survey of Dentistry in the United States.

Recommendations on which discussions will be held at the congress, which is scheduled for Saturday, Feb. 4, 1961, in the Williford Room of the Conrad Hilton Hotel in Chicago, are as follows:

—That dental schools give students more experience in working with auxiliary personnel.

—That the dental profession conduct studies designed to develop and expand duties of auxiliary personnel.

—That all state boards of dentistry accept results of the National Board Dental Examinations.

—That dental schools make their curricula more flexible and stimulating.

The Commission was responsible for the most extensive survey of dentistry ever conducted in the United States. Results of the survey were published in a summary report issued recently by the American Council on Education and called "Dentistry in the United States: Status, Needs and Recommendations."

Dr. Leslie M. FitzGerald, Dubuque, Iowa, chairman of the Association's Council on Dental Education, will moderate the morning session. Moderator of the afternoon session will be Dr. John E. Buhler, Atlanta, Council vice-chairman.

Attendance at the congress is expected to exceed 250, and all members of the Association are invited. Further information may be secured from Dr. Kenneth E. Wessels, assistant secretary of the Council on Dental Education, 222 E. Superior St., Chicago 11, Illinois.

Philadelphia County Dental Society to Honor Dr. Patton

The Philadelphia County Dental Society will honor Charles H. Patton, president of the American Dental Association, at a dinner at the Barclay Hotel in Philadelphia on Wednesday, March 1, 1961. A. A. O. members may obtain information and invitations by writing to the Society's Executive Office, Sheraton Hotel, 17th St. and Pennsylvania Blvd., Philadelphia 5, Pennsylvania.

University of North Carolina School of Dentistry Announces Teacher Training in Orthodontics and Pedodontics

Graduate Training Grant.—The National Institute of Dental Research has made available a graduate training grant, effective July 1, 1961, for the purpose of training teachers in either orthodontics or pedodontics. A Master of Science degree, or a degree of Master of Science in Orthodontics or in Pedodontics, will be granted by the Graduate School upon the successful completion of the appropriate curriculum.

Residency Retirement.—The curriculum in orthodontics requires nineteen months in residency, while the curriculum in pedodontics requires twenty-four months.

Training Stipend Available.—A sum of $5,000.00 is available for each trainee for a calendar year (twelve months), as well as the cost of tuition and a modest travel allowance to Chapel Hill.

Priority for Selection.—In addition to the requirements for admission as set by the Graduate School and the department concerned, selection will be based on the following

priority: (1) a candidate who has a formal agreement with a school of dentistry to teach orthodontics or pedodontics on a full-time basis subsequent to completion of the appropriate graduate program, (2) a candidate who has a similar agreement to teach orthodontics or pedodontics on a part-time basis, and (3) a candidate who has no agreement with a school at the time of the application but who agrees to teach on a full-time basis under given conditions.

Application Deadline.—Application must be completed by April 1, 1961, for classes beginning June 8, 1961. Candidates will be notified regarding their acceptance not later than May 1, 1961.

Additional Information.—Information may be secured by writing Dr. L. B. Higley, University of North Carolina School of Dentistry, Drawer 750, Chapel Hill, North Carolina.

Department of Health, Education, and Welfare

Some twenty experts in research and practice in the child welfare field conferred with Children's Bureau officials on Dec. 15 and 16, 1960, to discuss effective ways to enhance accomplishments in the child welfare field through research. The meeting, called by Mrs. Katherine B. Oettinger, chief of the Children's Bureau, was an early step in preparing to administer terms of a recent Social Security Act amendment which gives the Secretary of Health, Education, and Welfare authority to make grants for research or demonstration projects in the child welfare field. Congress has not yet appropriated funds to implement the amendment. When that step is taken, the Children's Bureau is expected to be charged with administering it under the Secretary's direction.

Under terms of the amendment, which was passed by the Congress in 1960, grants may be made to public or nonprofit institutions of higher learning or those engaged in research or child welfare activities to establish special research or demonstration projects in the child welfare field. Congress specified that such projects must be of "regional or national significance."

The Children's Bureau asked the group of experts to help it in identifying problems that stand in the way of effective help in the field of child welfare to children, including delinquent children. It also asked for the group's opinion about possible new means of prevention and treatment in the child welfare field that should be tested and about services that should be established on a demonstration basis because their value already has been recognized.

Death of T. G. Duckworth

It is with regret that we report the death of T. G. Duckworth of San Antonio, Texas.

District of Columbia Dental Society

The twenty-ninth annual Postgraduate Clinic of the District of Columbia Dental Society is to be held March 12 to 15, 1961, at the Shoreham Hotel in Washington, D. C. A full program of scientific sessions will include limited-attendance clinics, panel discussion, projected clinics, table clinics, a "Lunch and Learn" session, motion pictures, and scientific exhibits. A reception honoring A. D. A. President and Mrs. Charles Patton will head the many social events. The official program may be obtained from the District of Columbia Dental Society, 1835 Eye St., N. W., Washington 6, D. C.

Notes of Interest

Clarence R. Hien, D.D.S., and William N. McCormick, D.D.S., announce the formation of a partnership for the exclusive practice of orthodontics at 200 Park Ave. West, Mansfield, Ohio.

Robert E. Bedell, D.D.S., M.S., announces the removal of his office to 206 West Argonne, Kirkwood, Missouri, practice limited to orthodontics.

G. Franklin Forney, D.D.S., M.S., announces the opening of his office for the practice of orthodontics at 1112 Broadway Tower, Enid, Oklahoma.

J. Leon Furie, D.D.S., announces the opening of a branch office at 27 South Finley Ave., Basking Ridge, New Jersey, practice limited to orthodontics.

Edward M. Kelly, D.D.S., announces the opening of his office at 1033 Ingleside Ave., Baltimore, Maryland, practice limited to orthodontics.

Daniel Weinstock of 54 East Williston Ave., East Williston, Long Island, announces that since September, 1960, he has been in the exclusive practice of orthodontics in his additional office at 350 Ocean Ave., Brooklyn, New York.

Robert B. White, D.M.D., announces the association of J. Sidney Smith, D.D.S., M.S., practice limited to orthodontics, Suite 12, Dental Arts Center, Huntsville, Alabama.

Forthcoming meetings of the American Association of Orthodontists:

1961—Denver Hilton Hotel, Denver, Colorado, April 16 to 21.
1962—Statler Hotel, Los Angeles, California, April 28 to May 3.
1963—Hotel Fontainebleau, Miami Beach, Florida, May 5 to 9.
1964—Palmer House, Chicago, Illinois, May 10 to 14.
1965—Dallas Statler-Hilton, Dallas, Texas, April 25 to 30.

OFFICERS OF ORTHODONTIC SOCIETIES*

The AMERICAN JOURNAL OF ORTHODONTICS is the official publication of the American Association of Orthodontists and its component societies. The Editorial Board of the JOURNAL is composed of a representative of each of the component societies.

American Association of Orthodontists
(Next meeting April 16-21, 1961, Denver)

President, William R. Humphrey - - - - - - - - - Republic Bldg., Denver, Colo.
President-Elect, Dallas R. McCauley - - - - - - 410 S. Beverly Dr., Beverly Hills, Calif.
Vice-President, Cecil G. Muller - - - - - - - - 101 S. 35th Ave., Omaha, Neb.
Secretary-Treasurer, Earl E. Shepard - - - - - - - 225 South Meramec, Clayton, Mo.

Central Section of the American Association of Orthodontists
(Next meeting Oct. 1-3, 1961, Minneapolis)

President, Henry E. Colby - - - - - - - 1850 Medical Arts Bldg., Minneapolis, Minn.
Secretary-Treasurer, Kenneth E. Holland - - - - - - 1016 Sharp Bldg., Lincoln, Neb.
Director, G. Hewett Williams - - - - - - - - - - - 811 Elm St., Winnetka, Ill.

Great Lakes Society of Orthodontists

President, Hunter I. Miller - - - - - - - - - - - 1416 Mott Foundation Bldg., Flint, Mich.
Secretary, Edward A. Cheney - - - - - - - - - - 1201 Bank of Lansing Bldg., Lansing, Mich.
Director, Harlow L. Shehan - - - - - - 601 Jackson City Bank Bldg., Jackson, Mich.

Middle Atlantic Society of Orthodontists
(Next meeting Oct. 1-3, 1961, Atlantic City)

President, Paul V. Reid - - - - - - - - - - - Medical Arts Bldg., Philadelphia, Pa.
Secretary-Treasurer, Charles S. Jonas - - - - - - Mayfair Apts., Atlantic City, N. J.
Director, Louis E. Yerkes - - - - - - - - - - - - 825 Linden Ave., Allentown, Pa.

Northeastern Society of Orthodontists
(Next meeting March 5-7, 1961, New York)

President, Henry C. Beebe - - - - - - - - - - 60 Charlesgate West, Boston, Mass.
Secretary-Treasurer, David Mossberg - - - - - - 36 Central Park S., New York, N. Y.
Director, Norman J. Hillyer - - - - - - - - 230 Hilton Ave., Hempstead, L. I., N. Y.

Pacific Coast Society of Orthodontists
(Next meeting Aug. 6-10, 1961, Seattle)

President, E. Allen Bishop - - - - - - - - - - - 703 Cobb Bldg., Seattle, Wash.
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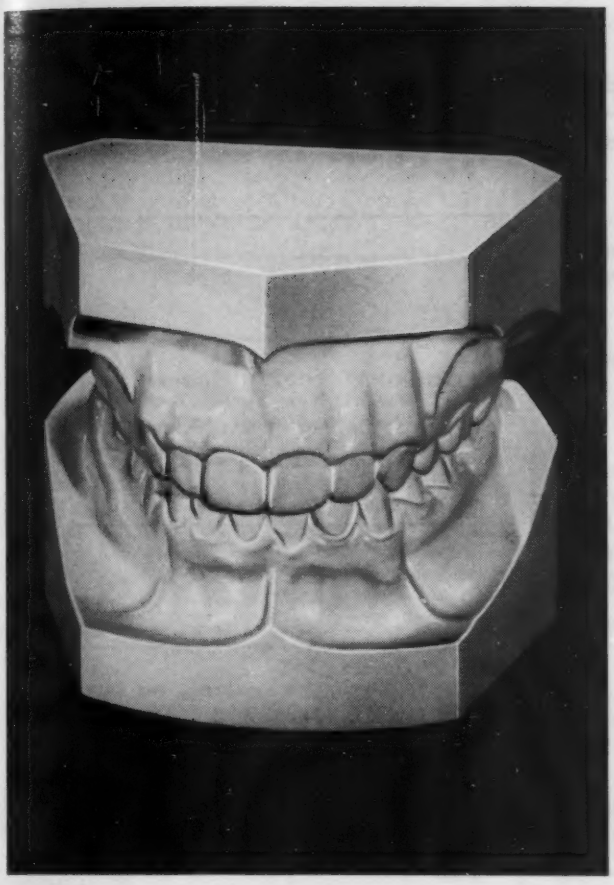

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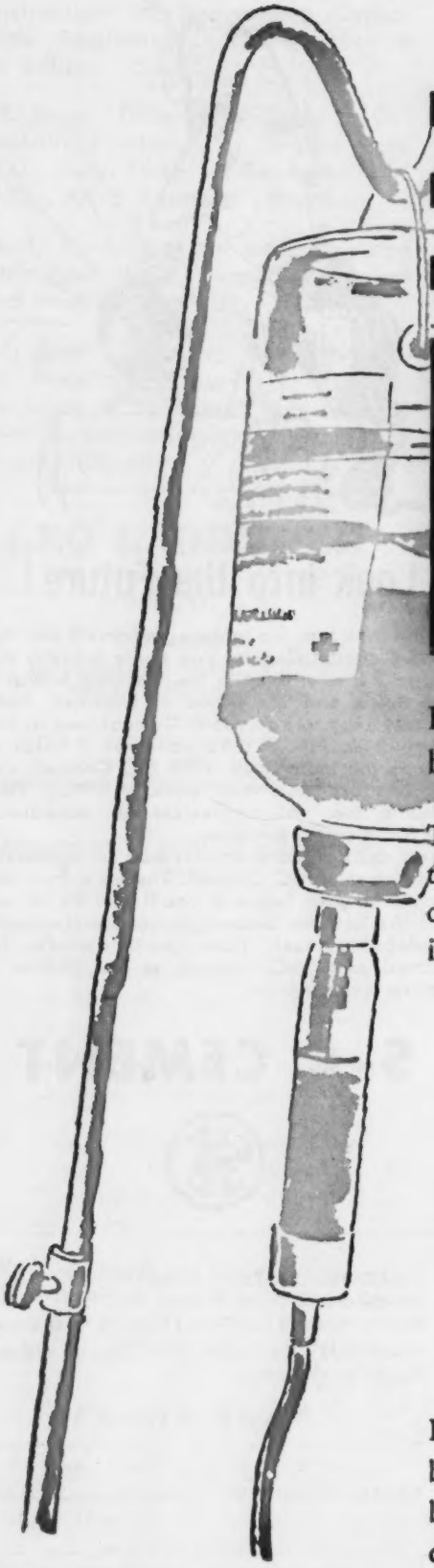

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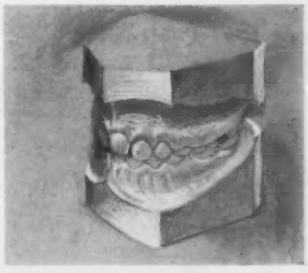

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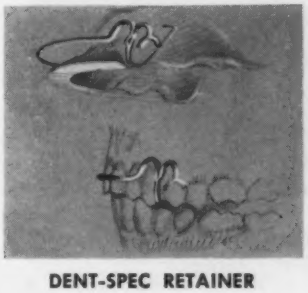

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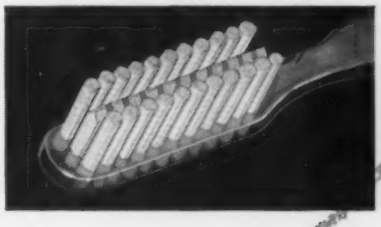

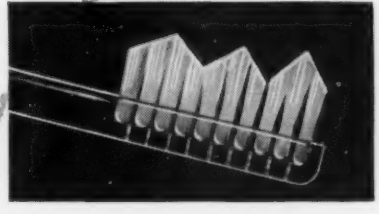

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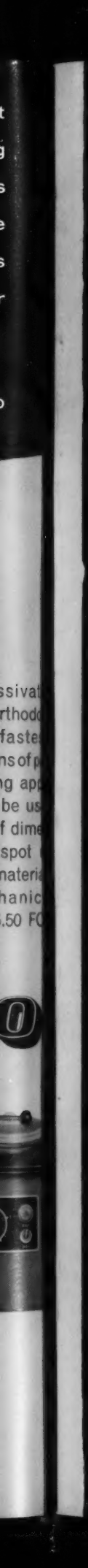

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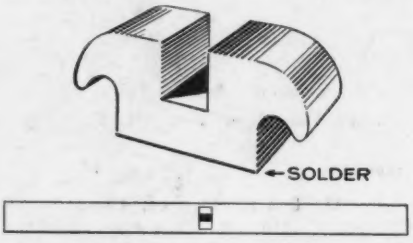

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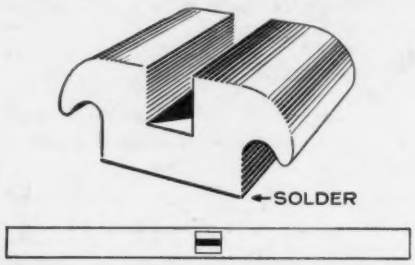

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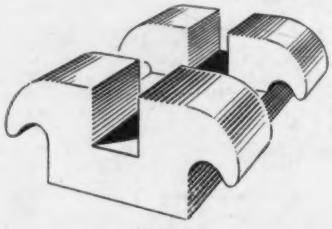

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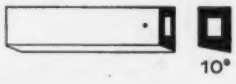

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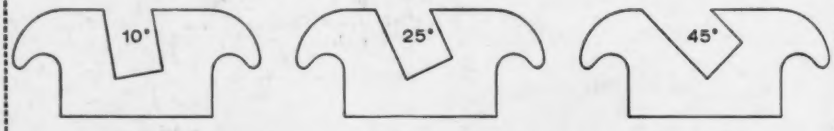

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